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The European Defence Industry

A Comparative Analysis of the European Defence

Technological and Industrial Base

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*To my family, who always stands by me,
to my friends, who share this life with me,
and to the One which has always leaded my path.*

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Introduction

The analysis on the European Union defence industry is valuable in many respects. First of all, under a pure strategic and military point of view, there is a growing necessity for the European Union to rely on its own capabilities in order to face mounting international threats, particularly in its neighbourhood. The progressive American disinterest of European military needs is one of the most worrying signals of a new era. On the one hand, the United States (US) are significantly reshaping their national foreign strategy concentrating their forces and attention on the East-Asian regions – as testified by the movements of the US aircraft carriers in the last months ¹; on the other hand, John Ikenberry has spoken about the “East Asianisation” process of Europe: particularly in the last year and after the equivocal declarations of Trump on the North Atlantic Alliance, it appears that the US are progressively adopting a strategy of bilateral preference, based on guarantees to individual countries who respects the US commands and interests. For, interestingly, during the last years US troops stationed on East European countries who respected the 2% GDP commitment on defence spending ². Second, under an economic standpoint, the defence industry has been shown to be very important in terms of productivity and spill-overs effects for the all economy: for instance, internet and GPS came both from military industry initiatives. For the same reasons, over the past decade, the European Union industrial policy has targeted defence as one of the most sensible domains as for the overall European competitiveness: in particular, being defence among the highest high-tech intensive sectors which also rely and massively develop the important “enabling technologies”. Finally, the defence industry is at the basis of the concept of the modern state: the capability of independence, effectiveness and the legitimate use of force are among the basic prerogatives of modern national states. For these reasons, European Member States have always been contrary to delegate this prerogative to supranational bodies. Since the last year, after the Trump’s election and the Brexit vote, the European defence industrial policy has recorded a significant revitalization and several proposals such as the European Defence Fund or the important developments of the Permanent Structured Cooperation have been addressed and endorsed by the European Commission and the European Council. The defence sector in Europe is an important domain where realistic and concrete proposals may change the future of the European Union itself. The present study is a comparative

¹ USNI *New Fleet and Marine Tracker*, (online) Accessible at: https://news.usni.org/2018/01/02/usni_ft_01_02_2018 (Accessed January 2018)

² Kundnan, H. (2017), *Donald Trump’s ‘East Asianisation’ of Europe*, (online) RUSI, Accessible at: <https://rusi.org/commentary/donald-trumps-east-asianisation-europe> (Accessed May 2017)

analysis of the European and American defence technological and industrial base. Following the example of Keith Hartley in *The Economic of Defence Policy*³, the United States of America has been chosen as a reliable benchmark to assess the performance of the overall European defence industry. The Structure-Conduct-Performance model has been preferred for the analysis because of the data available to the author as well as of comparability needs with the previous literature. The first chapter is divided in two section: in the first section a defined sample of military systems will be analysed in terms of their quality; in the second section, European and American military exports will be compared. In the second chapter, the average performance of the military industries across the Atlantic will be compared while in the third chapter, it will be analysed the main structural differences of the European and American defence technological and industrial basis. Finally, in the last chapter major results will be discussed while also providing some policy advices.

³ Hartley, K. (2012). *The Economics of Defence Policy*, Routledge, Abingdon (U.K.).

1. The Conduct of European and American defence industries

The main purpose of the first chapter is to give an overall assessment of the conduct and performance of defence industries in Europe and the United States (US). Due to the limited availability of free data, but also to a lack of expertise of the author in some fields of engineering, the analysis will be neither exhaustive, nor systematic; experts' opinions and the comparison of different professionals' standpoints will provide the main base of the research material. At the same time, this first assessment will shed some lights on major trends within the European and US defence industrial environment, their respective weight and performance. The first section analyses the conduct of defence industries by quality of the products and export performance. In the second part, the performance of main US and European defence companies are compared. Even though, it might be hazardous to infer the comparative advantages of the defence economies considered, along the chapter it will be presented the main driving forces that define the US superiority.

Price and non-price competition such as advertising, marketing, political lobbying, R&D, product differentiation as well as technological development are the main important elements to analyse the conduct of an industry⁴. For the military industry, competition is mainly based on non-price components, even though the recent developments of tighter defence budgets and mounting public debts have given to cost-effective solutions a prominent role⁵. Far away from being exhaustive, the analysis of the conduct of the European military sector compared to the US one wants to highlights some major differences and trends in the conduct of the two industries. In order to perform a comprehensive analysis, conduct will be assessed according to two main dimensions: the quality of some major military systems and the export performance by country and sector. As far as the latter is concerned, export trends give some important clues on marketing and political lobbying power. At the same time, regarding quality, new weapon systems tend to outperform old ones providing better cost-effective solutions. For, product differentiation in terms of high-/low- quality products is rather localized⁶ whereas the overall military industry stands by all means as low differentiated in terms of

⁴ Hartley, K. (2012). *The Economics of Defence Policy*, Routledge, Abingdon (U.K.).

⁵ Ibid.

⁶ For instance, Belharra, successor of La Fayette class frigate, is the new French combat surface vessel endowed with low sophisticated capabilities targeting some specific low-income segments of the international market. The same idea applies also to the British Type-31e concept which with its £250mln expected unit price is designed to penetrate a crowded foreign market. See also Childs, N. (2017), *US Navy's latest frigate plans: beyond LCS, but how far?* (online). Available at: <http://www.iiss.org/en/militarybalanceblog/blogsections/2017-edcc/august-b660/us-navy-ffg-7930> (Accessed 20 August 2017).

its output. At the same time, keeping the same quality, product differentiation is implemented as for to accommodate customers' strategic and military needs– e.g. the three F35 Lightning II models or the Eurofighter Tranches. All these considerations are extremely important while assessing the conduct of the defence industries, as they narrow the set of possible solutions for improving the performance of the industry (see below).

1.1. Quality

It is very difficult to assess the quality of a military product, particularly for high-tech, cutting-edge equipment. The main reason of this difficulty is given by the nature of the commodity we are dealing with. Which type of destroyer or fighter is the best military craft depends mainly on non-economic reasons, but rather strategic and military ones. Factor such as interoperability of different systems, integration with other forces, capabilities, versatility or high-end features might be the main determinants for assessing the quality of a specific product. Moreover, different war theatres and missions might render some elements redundant or even counterproductive. However, it might be argued that given the same military, strategic and capability objectives, different products might well be measured in terms of quality by field professionals and experts. Even though these critics might be welcomed, evidence shows that it is more and more the case for military equipment to assume some multiple capabilities for the same product. Given tighter budget constraints, countries prefer to purchase the best mix of versatility and effectiveness for the same product. In this regard, the United States in 2009 decided to rebalance the share of the air-to-air F-22 Raptor and air-to-ground F-35 Joint Strike Fighter, preferring the latter due to its more adaptable features, even though the high-end purposes of the two fighters are not directly comparable⁷. At the same time, geostrategic issues might dampen the capability of major military systems. For instance, learning from the last Afghan and Iraqi war, we know that in case of modern land warfare, armour protection is a fundamental component to counteract the wide spread use of improvised explosive devices (IED). However, the lower protection of the Infantry Fighting Vehicle (IFV) US Bradley compared to the Israeli Nimren does not derives from a lack of technology of the US industry. Rather this fact concerns a logistic problem: while Israel units are operating in war theatres close to the country, the US has to find the right balance of weight and effectiveness in order to minimise the transportation costs of high-weight

⁷ Bronk, J. (2014). *'4.5 Generation' Fighters – Multi Role Aircraft in Search of a Role* (online) Available at: <https://rusi.org/commentary/'45-generation'-fighters—multi-role-aircraft-search-role> (Accessed: 12th September 2017).

units to the battlefield⁸. For the same reason, the lack of an air-droppable fighting vehicle (AFV) in the US army does not depend on a missing technological capacity: these types of vehicles have already been produced and employed in the past in the US army⁹. Eventually, assessing the quality of a product in terms of its effectiveness and ability to respond to new threats does not always significantly point out the state and development of an industry. We could make the choice of the sample based on the priority given to a model by the user nation (the Mi-28 was chosen over the Ka-50 and Mi-24 because the Russian military has decided that the Mi-28 is its attack helicopter of the future) or state-of-the-art systems. However, the main problem is to understand what do we mean for “state-of-the-art” systems. For examples guided rocket systems with proven high degree of accuracy deployed by the US army could be less performing than their Chinese counterparts that claim higher range but less accuracy. This is mainly linked to the problem of developments in cyber security. The possibility of hacking these digitalized military systems might definitely nullify the effectiveness of the US forces. As the Rear Admiral Danelle Barrett, the US Navy Cyber Security Division Director, noted that “*the advent of networked systems and cyberwarfare has led military commands to begin training and planning for operations without them in the case an adversary denies them*”¹⁰. Given all these strategic, military and historical constraints, how can we assess the quality of a military product? Effectiveness measurements and comparisons aside, for the purposes of this analysis, we will focus our attention on specific high-technological characteristics and components of different military crafts. Indeed, this initial row assessment will proxy for the technological advancements of specific US military industries, compared to European ones. In this section, we will plot a primitive but detailed assessment of some land and air systems.

1.1.1. Fighters

The problem of comparing military products arises clearly from an early assessment of different fighters. Among possible classifications, different fighters can be evaluated according to their purposes. Air-to-air fighters present top features to establish air-dominance and they differ in

⁸ Gordon IV, J. et al. (2015). *Comparing U.S. Army Systems with Foreign Counterparts. Identifying Possible Capability Gaps and Insights from Other Armies*, Rand Corporation, Santa Monica (California)

⁹ Ibid.

¹⁰ Pomerleau, M. (2017). *The cyber paradox: Reliance on new tech can quickly become a weakness*, (online), available at: <https://www.fifthdomain.com/dod/navy/2017/10/27/the-cyber-paradox-reliance-on-new-tech-can-quickly-become-a-weakness/> (Accessed: 27 October 2017).

capabilities and technical requirements compared to air-to-ground or air-to-sea military aircrafts. At the same time, versatility requirements for high-threat environments, narrower budget constraints and the necessity to overcome increasing costs for successive generation of fighters have paved the way to the development and production of multi-role fighters, able to perform many different tasks and being deployed in land, air and sea forces. For the US and Europe, it is widely recognised that there are four major fighters: the F-22 Raptor and the F35 Lightning II for the US and the Eurofighter Typhoon and Rafale for Europe. In this analysis, the Saab JAS 39 Gripen will not be considered as it is widely recognised as the lowest-profile product available¹¹. According to their

	F-22 Raptor	F-35 Lightning II	Eurofighter Typhoon	Dassault's Rafale
Engine	Twin thrust-vectoring F119	Single: F135-PW-100 (A,C) / F135-PW-600(B)	Two Eurojet EJ200 turbojets	Snecma M88-2
Thrust/Weight ratio	1.26	1.07	1.15	0.988
Max. speed, armed internally	Mach 2.1	Mach 1.6	Mach 2.0	Mach 1.8
Range (miles)	2	1200(A,C) / 900(B)	1,802	1,15
MTOW (lbs)	54,999	59,966	51,809	54,013
Empty weight (lbs)	31,998	26,455	24,251	20,944
Max. altitude (ft)	50	50	64,993	49,984
Stealth technology	YES	YES	NO	NO
Radar	APG-77v1	AN/APG-81	Captor ECR-90	RBE2-AA (Thales, 2012)

Table 1 - Technical characteristics of major European and American fighters

purposes, while the F-22 Raptor and the Eurofighter retain high-end air-to-air capabilities, for air-to-ground missions the F-35 Lightning II and the Dassault Rafale multi-role fighters might present more suitable profiles. However, successive Tranches (enhancement of capabilities for the Eurofighter) has provided the Typhoon with multi-role features as well.

All these differences and specifications make these cutting-edge jewels more complementary than substitutes, some experts claiming for impossible comparisons. In this paragraph, I will not refer to generation of fighters since the topic is still much debated and there is not a unique standard. Furthermore, referring to fighters' generation, might be misleading for the purposes of our analysis, since we should focus on the technological developments of the above-mentioned aircrafts. Because of the difficult comparability of these products, we will not run a point-to-point comparison. Rather,

¹¹ Bronk, J. (2014). "'4.5 Generation' Fighters – Multi Role Aircraft in Search of a Role" (online), available at: <https://rusi.org/commentary/'45-generation'-fighters—multi-role-aircraft-search-role> (Accessed: 12th September 2017).

some European and US models will be judged according to high-end technological advancements within some specific domains, notably air-to-air, air-to-ground, intelligence, surveillance and reconnaissance (ISR) and electronic warfare (EW) capabilities and new materials. This approach reveals to be more consistent to detect the overall advantages of an industry.

Data in the Table 1 have been collected from several sources. Government reports, official analyses and companies' websites have been privileged; however, when not otherwise available, data have been sourced from defence-focused journals and websites. For instance, for comparisons between the Eurofighter and F-35, opinions and reports are acquired from the British Ministry of Defence (MOD). The UK is an important industrial partner in both the projects and the Royal Air Force is supposed to deploy both the Typhoon and the F-35 Lightning II by 2020. Moreover, since each source uses different units and benchmarks, none of the measurement in the table is exact: for example, the maximum range depends on the weight (if empty or loaded) and speed at which it has been evaluated. However, for the purposes of our analysis, even though not precise, the observations keep their general ranking position. Finally, data have been cross-referenced with opinions of major professionals, in order to double-check the consistency of the collection.

There are few major categories to assess the performance and technological development of any given aircraft. First of all, characteristics such as super cruise (sustained flight above Mach 1: fly at supersonic speed without using afterburners) and super-maneuvrability are essential (even though not sufficient) in high-end air-to-air fighters. Accordingly, the Eurofighter has the edge over Rafale in terms of top- or cruise speed and manoeuvrability thanks to its high thrust to weight ratio and aerodynamically unstable design. The service ceiling (maximum usable altitude of an aircraft) of the Typhoon is nearly 15,000 feet above the Rafale's one. Moreover, the thrust-vector-control (TVC) upgrade of the Typhoon make it possible to gain high manoeuvrability at top-speed. For the US, the F-35 has larger engine which hamper super cruise and super-maneuvrability options, compared to the Raptor's twin thrust vectoring F119s – for, the F-22 is able to fly at supersonic speed without using afterburners which are extremely fuel-consuming. Even though the Eurofighter has proved to perform well at the annual Red Flag exercise¹², the F-22 is widely recognised as the king of the air-superiority with outstanding speed and manoeuvrability features as demonstrated by its top speed (Mach 2.1) and high thrust to weight ratio (1.26).

¹² Bronk, J. (2015). *Maximising European Combat Air Power. Unlocking the Eurofighter Full Potential*, Royal United Services Institute, London (U.K.)

In terms of air-to-ground capability, the Rafale is a more capable strike platform compared to the Eurofighter. However, as pointed out by Justin Brook, a Research Fellow specialising in combat airpower and technology in the Military Sciences team at RUSI (the Royal United Services Institute for Defence and Security Studies), there is some room for upgrades of the Typhoon to match the Dassault's model capabilities: "*The performance and load-carrying capabilities of the jet mean that it can be made substantially more capable in the strike role than legacy designs*"¹³. As far as air-to-ground capabilities are concerned, the F-22 fall far from other competitors while it is not possible to claim the F-35 superiority over Rafale, some experts claiming each fighter might be best deployed according to different mission requirements.

Except for the F-22 high specialization in air-superiority, all the other models are claiming a "multi-role" capacity. However, we should notice that super cruising and high manoeuvrability for dogfight performances decrease at increasing rate of heavy load of strike munitions and extra fuel tanks so that the 'omni-role' profile is rather a matter of trade-offs.

A third category to assess the performance of a fighter is according to radar, sensors and electronic warfare capabilities as well as the stealth design. In this domain, the United States are definitely the world leaders. Both their fighters have undiscussed superior capabilities. Not only the radar (F-22A's APG-77v1 has a much longer range than any one of its competitors) and the sensors (the F-35's all-aspect Distributed Aperture Sensors (DAS) reportedly allow 360-degree targeting of aircraft around) enhance the capability of Intelligence Surveillance and Recognition (ISR) and Electronic Warfare (EW) of the American products, but also the sensor-fusion engine is a central concept in the new-generation aircraft, notably for the F-35: "*For example, the AN/APG-81 radar might detect and analyse the returns from a hostile aircraft. The fusion engine would then cross-reference this with any infrared signature and passive emissions detected against a database of known threats before presenting the pilot with a threat-identification much more concrete than one which relies on a single sensor. The pilot is, therefore, able to interrogate the pre-processed data from multiple sensors to make extremely well-informed judgment calls.*"¹⁴ Additionally, the low-probability-of-intercept Multifunction Advanced Data Link (MADL) allows data and information exchanges with other forces and enhance the awareness of the overall threat environment. All these characteristics make it redundant the use and deployment of some air low-defended assets for ISR

¹³ Ibid.

¹⁴ Bronk, J. (2016). *Maximum Value from the F-35. Harnessing Transformational Fifth-Generation Capabilities for the UK Military*, Royal United Services Institute, London (U.K.)

operations. At the same time, due to the high-classified nature of these type of equipment it is rather difficult to conduct an in-depth analysis and comparison among the existent radars and sensors. However, the cutting-edge and undiscussed superiority of the American fighters are widely recognised. Notably for the F-35 these new high-tech capabilities and integration along with the stealth design are the main reasons of the leap forward of this aircraft, a truly 5th generation fighter. All these characteristics are rather transversal to the usual air-to-air or air-to-ground profiles and play the role of real force-multipliers in high-threat environments. In this sense, as will be detailed later in this analysis, it is interesting to notice how new technologies and the so-called “enabling technologies” play a central role even for military systems. Interestingly, Jeannie Hilger, vice president and general manager of Northrop Grumman’s communications division, has claimed that *“in buying F-35, nations are gaining an enabler in the battle space, an asset whose real potential lies in its ability to be a force multiplier to one’s existing assets”*¹⁵. We should finally remind that all the potential of the F-35 will be unlocked only in a future and more mature phase. On the 26th of October 2017, the US Government Accountability Office has reported that *“Spare parts shortages are degrading readiness”* of the F-35 Lightning II program to meet demand¹⁶. The promises of the F-35 has therefore yet to be fully met.

1.1.2. Attack Helicopters

Helicopter	Operational Introduction	Number in Service	Export Location	Max Weight/ Max Payload	Max Speed (max/cruise)	Max Range
AH-64E Apache Guardian	2012	690 (planned)	Taiwan and South Korea; possibly Qatar, UAE, and Saudi Arabia	23,000 lbs	158/143 knots	260 NM
AH-1Z Viper	2010	226 (planned)	South Korea	18,500 lbs 5,764 lbs	155/134 knots	370 NM
Eurocopter EC665 Tiger	2003	France: 120 (planned) Germany: 120 (planned)	Australia, UK, Netherlands, and Spain	14,553 lbs 3,968 lbs	150 124 knots	430 NM

Table 2 - Attack Helicopters : general characteristics. Source: Gordon IV, J. et al. (2015). *Comparing U.S. Army Systems with Foreign Counterparts. Identifying Possible Capability Gaps and Insights from Other Armies*, Rand Corporation, Santa Monica (California)

¹⁵ Hilger, J. *Are We Ready for the F-35?*, (online) Financial Times/Northrop Grumman microsite, Available at: www.northropgrumman.ft.com/#!/ready-for-f35 (Accessed 18 July 2017).

¹⁶ GAO, *F-35 Aircraft Sustainment: DOD Needs to Address Challenges Affecting Readiness and Cost Transparency*, Report to Congressional Committees, GAO-18-75, 26 October 2017.

This paragraph reports some of the most important conclusions of an accurate project sponsored by the Director of Force Management and conducted within the RAND Arroyo Center's Force Development and Technology Program. As the project's title suggests - "Comparing U.S. Army Systems with Foreign Counterparts. Identifying Possible Capability Gaps and Insights from Other Armies" – the idea was to provide US officials with improvements opportunities of American military systems. The recent date of publication (2015) make it a valuable and reliable source for the purposes of our analysis. Eventually, the report's sample of selected systems allow us to derive some useful insights and conclusions for the relative strengths and weaknesses of European and US helicopters.

Among other helicopters, the RAND project compared the US AH-64E and AH-1Z Viper, manufactured by Boeing and Bell respectively, with the Franco-German Eurocopter EC665 Tiger. Other platforms such as the A-129 Mangusta were screened, but specific platforms were chosen based on the priority of the system to the user nation.

All these helicopters are built with composite materials and all-glass cockpits with liquid crystal display (LCD). However, the US attack helicopters lead in target system capability thanks to the possibility to receive and transmit unmanned aerial system (UAS) and their use of cutting-edge forward looking infrared (FLIR) devices. On the other hand, the Eurocopter Tiger shows improved electromagnetic pulse (EMP) capabilities and a greater range than its US counterparts, even though reduced maximum weight and payload capabilities. On balance, American attack helicopters seems to perform better than European ones. However, Europe has some niche technological advantage.

1.1.3. Main Battle Tanks

Among all the armoured fighting vehicles (AFVs), I decided to focus my attention on Main Battle Tanks (MBTs). The reason of this choice depends on the more conventionally defined philosophy that underlines these types of military crafts. For example, in the case of the infantry fighting vehicles (IFVs), each country has rather tailored the product according to specific strategic needs, making it more difficult the technological comparison. Moreover, the deployment of the new Russian MBT

Vehicle	Country of Origin	Date of Introduction	Crew/ Dismounts	Status/Number in Service	Exported?	Combat Weight (short tons)
M1A2SEP V2 Abrams	USA	1992	4	Approx. 580 M1A2s and 580 M1A2 SEPs	Egypt, Kuwait, Australia	69.54
Merkava Mk 4	Israel	2003	4/8; ambulance version can carry 3 litter patients.	Approx. 400 in service; 300 more to be delivered	Merkava 4 not offered for export; Merkava 3 is	65
Leopard 2A6	Germany	2007	4	225 in German Army; more than 3,000 of all Leo 2 variants	Netherlands, Portugal, Canada, Spain, Greece	62.3
T-90	Russia	1995	3	743 in Russian Army	India (650), Algeria (305); Azerbaijan, Saudi Arabia, and Turkmenistan have placed orders	47.5

Table 3 - Main Battle Tanks : general characteristics. Source: Jane's Armor Artillery (2013)

Armata in the near future will boost development of new solution to counteract what a senior UK Army intelligence officer called: “*the most revolutionary step change in tank design in the last half century.*”¹⁷

As the previous paragraph, the 2015 RAND report outlines some important differences of European and US MBTs. In particular, Table 3 compare the US Abrams with the German Leopard. Overall, report concludes that the Abram MBT preserve an advantage in areas such as fuel options for turbine engines, even though top speed is similar to the German tank. While the US has not developed a high-explosive fragmentation round, the use of depleted uranium ammunition allow the US M1A2 to keep the edge over the Leopard. Finally, both these tanks perform well as it comes to FLIR. However, it worth noticing that the last version of the Abram comes with the Common Remotely Operated Weapon Station, with improved target acquisition and engagement capabilities. Interestingly, the RAND report suggests improvements in vehicle sensors as the best way to preserve the technological and strategic superiority of the US Army:

¹⁷ Mendick R. et al. (2016), *UK military intelligence issues warnings over Russian supertank threat*, (online). Available at: <http://www.telegraph.co.uk/news/2016/11/05/uk-military-intelligence-issues-warning-over-russian-super-tank/>, accessed June 2017.

“Improvements to vehicle sensors will be necessary to regain the battlefield advantage that the Army enjoyed in 1991 and 2003 due to its early adoption of first and second-generation FLIR systems. The Army should invest research and development funds and expand on existing technology to preserve and extend the current tactical advantage these vehicles have in direct fire capability in all weather and visibility. Improvements in sensors and direct fire targeting have the potential to substantially affect multiple classes of combat vehicles, including the Army’s MBTs, the Bradley and its eventual replacement, and other systems employing stabilized direct fire weapons, such as the Stryker mobile gun system (MGS). Research and development options that the Army could consider include (1) how to degrade the increasingly capable FLIRs that are appearing on foreign systems, and (2) if there other direct fire sensor technologies that could supplement or replace FLIRs in order to maintain the Army’s direct fire advantage.”¹⁸

1.1.4. Conclusions

The paragraph was an attempt to compare some European and American military systems in terms of their quality. The analysis lacks completeness and accuracy due to major problems such as the impossibility to find the necessary material due to the high-classified nature of the subject. Many other products had been screened such as frigates, aircraft carriers, missiles and so on. However, the sample choice depended on the availability of the material: for the products chosen, many sources were available that kept the right level of accuracy needed. Certainly, an important missing factor is the evaluation and comparison of naval systems and missiles. In addition, since the analysis tried to focus on the cutting-edge and leading international components of a specific system, for sake of completeness it might be useful to investigate supplier markets to defence primes. The analysis of the supply chain would show where the technological advantage comes from and what is the size of the gap between US and European industries. For example, the avionics of the F-35 Lightning II keep the edge over any other existing system; in this sense, it might be interesting to detail which are the main differences compared to other solutions and which other EU and US competitors are on race. The supply chain analysis might continue to third or fourth supplier market for the same component and should particularly highlight the so-called “bottleneck” inputs that are essential to guarantee the competitiveness of the final product.

¹⁸ Gordon IV, J. et al. (2015). *Comparing U.S. Army Systems with Foreign Counterparts. Identifying Possible Capability Gaps and Insights from Other Armies*, Rand Corporation, Santa Monica (California).

However, beyond all these limitations, it is possible to derive some important insights from the previous analysis. In fact, though in terms of automation, engine power and engineering European and US products do have similar features and capabilities, as it comes to new materials, digital systems and new radar and sensor technologies, the US are certainly some steps forward. Even though it was not included in the analysis since it was not possible to find a European counterpart, it worth mentioning that as it comes to guided rocket artillery, the US leads in the field of accuracy compared to Chinese and Russian products¹⁹. This remark is extremely interesting and will be later discussed and detailed because it is strictly connected to what the European Commission address to be the main problem of the competitiveness lack of the European economy: the so called “enabling technology”. The US advantage in the Networking Economy make it also a standard-definer for products that necessitate a high degree of interoperability, such as military systems. This technological dependence is also perhaps one of the main reasons of the difficulty the European Union has in developing its own business.

1.2. Exports

As far as military crafts are concerned, evaluating the price-quality trade off in terms of export performance might lead to wrong conclusions. The demand side of a specific military system might be driven by political reasons rather than economic ones. For instance, as reported by Enzo Casolini, a former Eurofighter GmbH Managing Director, the 2011 Japanese decision to purchase the Lockheed Martin F-35 rather than the Eurofighter Typhoon was mainly driven by political reasons²⁰. Equally, only the US is able to provide the necessary strategic and military support South Korea needs in its region; for, the South Korean requirement to keep the close relationship with the US is a great obstacle for a successful European bid.

In addition, interoperability requirements provide standard-setters with strong advantages within military alliances. For instance, Link 16 is a strategic exchange network used by NATO and its communication component is the Multifunctional Information Distribution System (MIDS). Perhaps, it is not by accident that the MIDS International Program Office, charged to develop the MIDS for Link 16 is set in San Diego. Hence, not only the private sector and its capacity to properly

¹⁹ Ibid.

²⁰ Lora Lamia, S. (2013), *F-35 vs Typhoon: la parola all'ex AD(italiano) di Eurofighter*, (online) Available at: <http://www.analisidifesa.it/2013/10/f-35-vs-typhoon-la-parola-allex-ad-italiano-di-eurofighter/> (Accessed 10 September 2017).

lobby the government, but the state itself is an important element in the international success of national military products. Accordingly, in 2011 David Cameron and Nicolas Sarkozy committed themselves in a strong propaganda to win the Indian bid for a new fighter, respectively supporting the Typhoon and the Rafale. In fact, the state leverage power can take different forms: direct (defining world industry requirements) or indirect (such as economic offsets, benevolent approach towards other sectors and favourable trade terms as well as political advantage such as military support or international recognition). All these non-economic elements can be rightly summed-up in the “lobbying capacity” concept and they provide additional insights on the conduct of an industry. Reportedly, the lobbying capacity of an industry-state system can be consistently operationalized in terms of export performance.

In this paragraph, I will compare the export patterns of US, the European Union and main European countries (notably, UK, France, Germany, Italy and Spain). The analysis is built on the Stockholm International Peace Research Institute (SIPRI) trend-indicator value (TIV) of arms exports from 1989 to 2016 and it is freely available from the SIPRI website. The TIV does not represent sales prices for arms transfers; for, it is not directly comparable to other indexes like the GDP or total export. SIPRI TIV is “*based on the known unit production costs of a core set of weapons and is intended to represent the transfer of military resources rather than the financial value of the transfer*”²¹. Moreover, the value for transfer of weapons that have already been used or modified by the supplier before delivery is set respectively to 40 and 66 per cent of its original price.

1.2.1. Country-level

In this following section, it will be run a general study of EU and US import and export behaviour. For, we would like to show the relative strengths and weaknesses of the economies considered.

Ideally, the Balassa index (or revealed comparative advantage indicator) would provide the best quantitative measure to detect comparative advantages. However, sourced trade data do not take into account military products and refer to different price benchmarks (reportedly, SIPRI TIV is at constant 1990 price); moreover, as already stated, the TIV cannot be directly compared to GDP and exports, being a specific index operationalization. Nonetheless, it is possible to gauge some useful information on the different country-level economic strengths by comparing and decomposing the TIV itself. As regards to this first section, to facilitate analysis, data have been downloaded from the

²¹ From SIPRI website: <https://www.sipri.org/databases/armstransfers/sources-and-methods>

World Bank (WB) database which has in turn extract the observations for arms exports from the TIV SIPRI database. However, it worth warning that aggregate data for the European Union take into account also intra-EU trade: as it will be detailed, this fact pose major problems as it comes to imports evaluation.

First of all, Figure 1 (Fig. 1) presents the EU and US trade balance by Trend Indicator value of arms exports (TIV_TB). Interestingly, the graph shows that the EU has

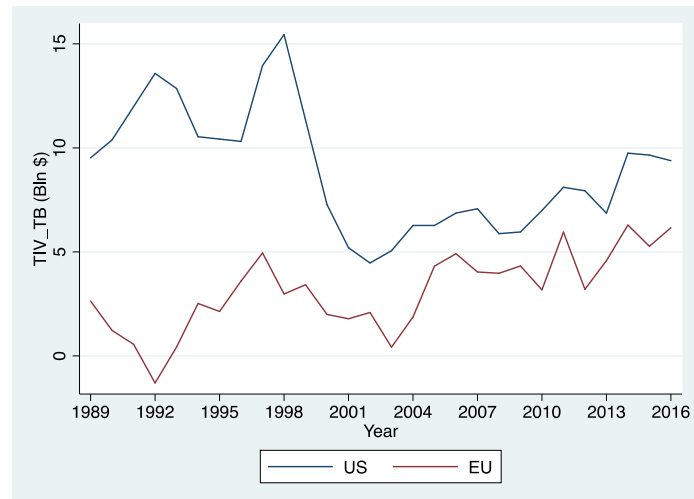


Figure 1 – TIV Trade Balance value for the US and EU (Source: SIPRI)

been able to reduce the trade balance over the period considered: beyond the temporary outstanding performance of the final years of the 1990s and the following sharp drop in the first period of the 2000s, the US have finally settle in the 1989 value; contrarily, the EU trade balance value shows a slow but constant growing performance, roughly catching up with the US path. Decomposing the trade balance indicator make it possible to derive further insights. As far as exports are concerned, it appears that the US struggle to recover the sharp drop of the end of the 1990s, while the European Union export conduct has remained generally unchanged. For, on the export-side the gap reduction is mainly driven by the US performance deterioration (Fig.2). Even though it might be interesting to explain the reasons of the US unexpected export collapse, for the purposes of this analysis it is sufficient to show that during the last decade, the US have regained much of the early 2000s, 4-year

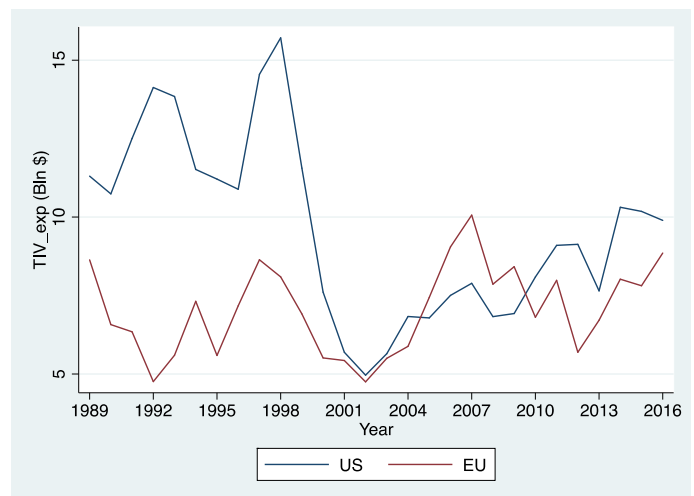


Figure 2 – TIV Export value for the US and EU (Source: SIPRI)

loss. On the contrary, while the US imports have remained stable over the period considered, the EU has clearly succeeded in reducing its foreign dependency which made it possible to increase its overall doing with respect to the US (Fig. 3). However, we should be cautious to derive any straight positive correlation between trade inflow shrink and improve industrial performance - notably, as countries prefer to buy national products. First, as already mentioned, the European Union takes (into account

also infra-EU trade: to be able to understand whether the EU international dependency has been reduced, we should detect how much of the total import reduction comes from extra-EU countries. Second, it might be the case that the contraction comes mainly from eastern Europe, far less industrialized and much more import-dependent as it comes to the military sector: for, the import reduction might be caused by tighter defence budgets of Eastern European countries. Finally, it worth

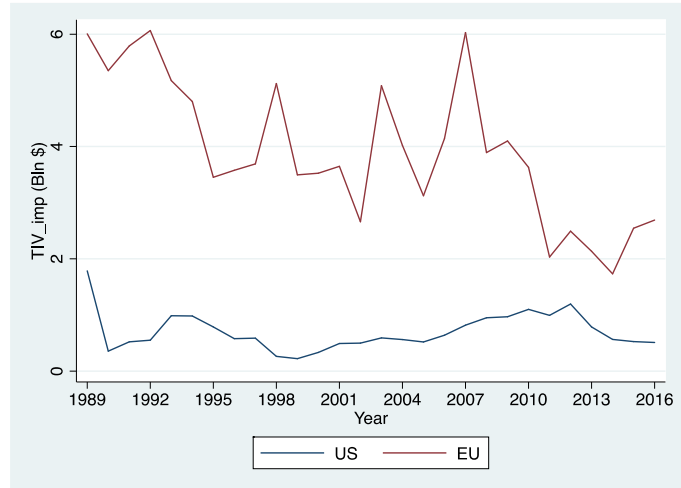


Figure 3 – TIV Import value for the US and EU (Source: SIPRI)

also noticing that the only time-span where the EU exports outperformed the US ones was counterbalanced by an abnormal import value, making it difficult to assert that European industries have been able to overtake their US competitors in terms of conduct. On balance, it is possible to conclude that, the nearly insignificant US import value make a strong case for the US military industrial strength, being able to operate to quasi-autarchy conditions. At the same time, notwithstanding the positive trend, Europe is still lagging behind in terms of trade balance and export performance. Which are the explanatory elements that account for the European deficit? Which European defence sectors outperform the US ones and which others contribute to widen the gap?

1.2.2. Sector-level

In this second section, we would like to detail the main determinants of the US performance, compared to major European countries. Data have been directly sourced from the TIV SIPRI database in order to analyse different military systems. A bunch of EU countries have been selected - notably UK, France, Germany, Italy and Spain - accounting on average for the 81.3% of the total EU export value over the period considered (ranging from a minimum of 70.3% to a maximum of 88%). Finally, in order to derive safer conclusions on the relative sectoral performance, only exports will be considered. Using TIV SIPRI data on arms transfers over the period 1989-2016, we will build a gap trend for major weapon categories. The “gap_TIV” variable is built by subtracting the total European TIV value to the US one by year and weapon category. Eventually, for “gap_TIV” negative values, the European defence industries have taken over US ones in terms of export performance: these

sectors help narrowing the overall gap between European and US military exports. Moreover, the UK special relationship with the US and its decision to leave the European Union in 2016 will be considered. Even though it is not possible to conclude anything for the future UK-EU relationship as it comes to the military industry, for completeness' sake, it will be detailed a comparison of total European exports without the UK. Accordingly, each graph will present two scenarios: the EU5 and the EU4 (without the UK).

Figure 4 shows the US dominance for exports of aircrafts. The SIPRI dataset use a broader notion of aircraft, including in its definition also helicopters and unmanned air-vehicles (UAV) with a minimum loading weight of 20Kg. Here, the Gap_TIV index assumes its greater values compared to all the other sectors, ranging from nearly 2 billion to more than 8 billion dollars²². This trend

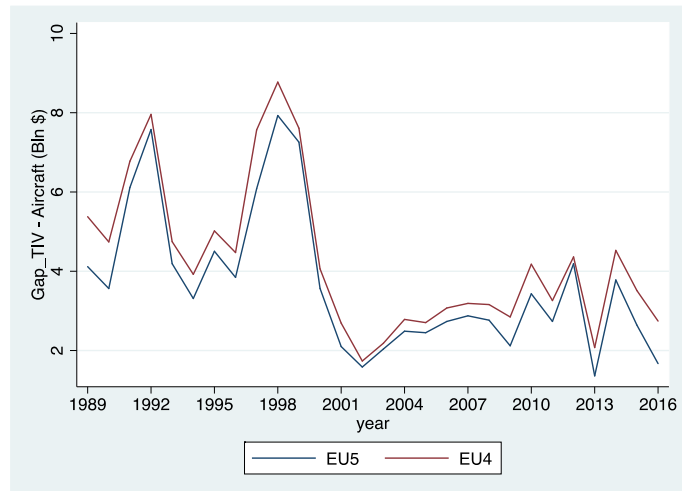


Figure 4 – Gap_TIV for Aircrafts (Source: SIPRI)

confirms our early analysis about the superior quality of US fighters. The Eurofighter Typhoon deliveries can explain the early 2000s sharp gap reduction; in fact, the recent decision to modernize the German air force will represent a turning point: to significantly lower unit production costs, the Eurofighter Typhoon programme needs to rely on the massive German procurements²³; for, which fighters will replace the old Tornado fleet will also represent an historical judgment of the Eurofighter program²⁴.

The US superiority is evident also for missiles: even though the differential is lower compared to aircrafts, it appears that the United States have been able to regain much of the edge of the 1990s in the aftermath of the 2008 financial crisis (Appendix I). The trends for aircrafts and missiles seem to confirm our expectations regarding the American superiority for military systems intensive in the use of new technologies whereas for low new-technology-intensive products such as artillery, European countries are keeping the edge (Appendix I). Moreover, missiles and aircrafts are two key

²² See Oxford dictionary (online), Accessible at: <https://en.oxforddictionaries.com/explore/how-many-is-a-billion> (Accessed 10 July 2017)

²³ Siebold, S (2017), *Germany favors Eurofighter as it seeks to replace Tornado*, (online) Reuters, Accessible at: <https://www.reuters.com/article/us-germany-defence/germany-favors-eurofighter-as-it-seeks-to-replace-tornado-idUSKBN1E52EK> (Accessed the 15th December 2017).

²⁴ Smith, R.(2017), *Boeing Has 2 Chances to Beat Lockheed*, (online) Available at: <https://www-fool-com.cdn.ampproject.org/c/s/www.fool.com/amp/investing/2017/11/19/boeing-has-2-chances-to-beat-lockheed.aspx> (Accessed 20 November 2017).

sector that make it difficult to predict the post-Brexit scenario: BAE Systems is a major partner in the European missile manufacturer monopoly (MBDA) and a key developer of the Eurofighter Typhoon concept; it is not by accident that the 2017 has seen a Franco-German declaration for the development of a new 5th generation aircraft where the role of the UK has not yet clarified²⁵.

The Gap_TIV trend for Sensors has recorded negative values from 2013 onwards (Figure 5). This fact is contrary to our expectations and pose major doubts on the reasons we addressed of the American superiority in aircraft and military systems. At the same time, it is not possible to detail and explain the pattern for Sensors: first of all, the sharp drop began in 2011 and it is still too early to understand whether it was a temporary shock or a permanent one; at

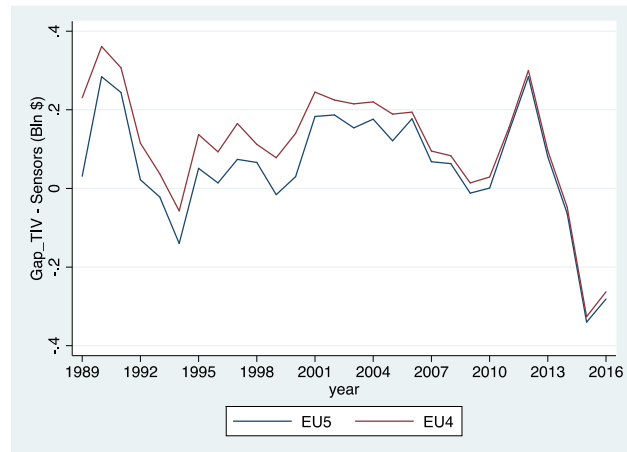


Figure 5 – Gap TIV for Sensors (Source: SIPRI)

the same time, the reason of this unexpected pattern might rely on demand driven processes or international supply chain issues. As far as the former is concerned, it might be the case for US defence sensors suppliers to have fully diverted their production towards national demand and have consequently met their possibility production frontier, without being able to export anymore. At the same time, while US sensors producers might need to satisfy the increased request of national defence primes, European firms might have benefit from this situation at the export level.

Another important secondary market where the US is claiming its superiority is that of engines. Here is where the eventual loss of the UK in the definition of a European defence industrial policy will be especially perceived. The UK in this case is basically making the difference as of the European capability to catch up with US suppliers – Rolls-Royce is a world-wide prime in the defence engine market. On the opposite side, for air defence systems, military vehicles and artillery, the British contribution is roughly null (Appendix I). Finally, a potentially interesting sector is that of shipbuilding. In this case, it seems that European countries are performing better than their US counterparts. In the hypothesis that this figure is not mechanically biased by the high number of European shipbuilders, it might be the case of a real European comparative advantage. This remark

²⁵ Foreign Staff, Telegraph (2017), *France and Germany announce plans to build jets together*, (online), Available at: <http://www.telegraph.co.uk/news/2017/07/13/emmanuel-macron-demands-germany-gives-cash-europe/> (Accessed 15 July 2017)

is especially interesting if we think to the recent developments of the European naval sector such as the acquisition of STX by Fincantieri in October 2017²⁶.

1.2.3. *Conclusions*

In this first section, we tried to compare the European and US defence industries in terms of their conduct. Conduct was operationalized by assessing the quality and the commercial performance. As far as the former is concerned, we have already draw some major conclusions: the evident superiority of US firms as for the so called enabling-technologies and networking economy. As regards to trade, imports majorly reduce the trade balance gap between EU and US. However, to assume an improved performance of European firms, it would be necessary to deepen the analysis by extra/intra EU trade and western/eastern European countries. At the same time, the export performance analysis, has proved the American superiority. Arguably, the economic and political leverage is a significant explanatory reason in the better performance of the US that it is not possible to isolate. On balance, while confirming some of the expectations, the export analysis has paved the way for further and deeper research especially as for sensors and shipbuilding. Finally, the contribution of the United Kingdom to the overall European performance results to be rather significant. Its expertise is of valuable importance in terms of the quality of European products and the export performance of the Old Continent defence technological and industrial base (DTIB) is threatened, notably as it comes to engines. The exact loss of this partner in the European industrial scenario would mainly depend by which kind of agreement will regulate the future EU-UK defence industrial relationships.

²⁶ Fontarosa, A. and Minella, M. (2017), *Stx, Italia e Francia con il 50% a testa. Ma Fincantieri in maggioranza per dodici anni*, (online) Accessible at: http://www.repubblica.it/economia/2017/09/27/news/cantieri_naval_i_telecomunicazioni_tv_e_spazio_tra_francia_e_italia_u_n_intesa_su_4_punti-176616852/ (Accessed 1 October 2017)

2. Assessing the Defence Industry Performance

The second step of our analysis is the assessment of the performance of US defence companies vis-à-vis European ones. Since it has been reasoned in terms of the US superiority for military products quality and exports, we expect these patterns to be confirmed in this section. Using a Bloomberg Terminal, we built a database of all the Aerospace and Defence companies as defined by the Bloomberg Industrial Classification Index (BICS). The Aerospace and Defence category has been preferred to the Defence Primes one because it accounts for some important defence primes that were not listed as simple Defence firms such as Boeing or Airbus. Even though it might be less accurate, we strongly believe that this category suits better our interests and it is still a very representative sample due to the similarities of the Aerospace firms and Defence ones: not only these two sectors are highly concentrated and present similar features in terms of structure, but it is often the case for the aerospace companies to have minor activities in the military sector as component suppliers. The BICS primary measure to determine main business activity is revenue; however, other quantitative and qualitative elements are also considered²⁷. The sample chosen takes into consideration the primary security of company with active trading status for each year considered; for, subsidiaries of a parent firm do not figure as separate entities if they do not have their own security. To check for the reliability of our database, we cross-referenced the SIPRI top-100 defence primes with the Bloomberg dataset. Interestingly, 17 out of the SIPRI top-20 EU and US defence primes are listed in our database. However, the match appears to be quite difficult since the Bloomberg database takes into consideration only publicly traded company and do not account for private company such as MBDA. There is, moreover, one main obstacle in a clear-cut assessment of defence industries performance. Since many defence companies differentiate their activities both in the civil and military market, it might be difficult to track the real performance of the military component. The technology used in many military systems and products can be often applied or otherwise implemented in other civilian crafts. For example, the know-how or material necessary for developing fighters might be easily transferred to some civil aircrafts. In this way, the high research and development (R&D) costs for developing cutting-edge products both in the civilian and military market would be spread over a wider output. This strategy is consistent as long as the costs of reconversion from military to civil technology are less or equal to the benefits of increasing the scale of production and access new markets. As long as the accounts and budgets of major military firms do not detail the different costs

²⁷ See Bloomberg, DOCS 2072704

and revenues that comes from military and civil activities, it is quite impossible to understand where the profits or real competitiveness comes from. This lack of transparency, combined with the dual nature of major military firms worldwide pave the way to transfer pricing practices and result in a significant competitive deficit for Europe: in fact, European companies do not benefit of the same demand the US Department of Defence (DoD) guarantee to American firms. Interestingly, the SIPRI database provides an index for the share of military sales over total sales. Unfortunately, it has not been possible to build the same indicator in the Bloomberg dataset. The impossibility to isolate the analysis to military activities represents the most serious drawback of our analysis. In the extreme case, military undertakings costs equal revenues, whereas the civil side account for the majority of a firm profit.

Performance has been operationalized in terms of six major indexes divided in two main groups. The first group refers to some indexes of financial performance such as Market Capitalization (Mkt_Cap, value in million dollars), Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA, value in million dollars) and returns on equity (ROE). The second group of indicators express more accurately the efficiency and productivity levels of the industry: Returns on Invested Capital (WACC_ROIC), Sales to Total Assets (Sales_TA) and Returns on Assets (ROA). Moreover, in some cases it will also be presented some adjusted indicators that exclude the impact of abnormal items. Remarkably, the performance indicators show the overall state of the subject as they snapshot the current situation; on the contrary, productivity and efficiency indicators coupled with their growth values, highlights the most important trends. All values are the average value of the corresponding financial year (FY). Finally, for the purposes of this analysis, the initial sample have been restricted to all those companies that present a tangible asset value greater than 1000: this is important especially for efficiency and productivity measures as to lower the risk of outliers due to the nature of the main business activity – notably, ROA is calculated as the Trailing Twelve Months Net Income value divided by total assets: service companies which have notoriously low levels of tangible assets might therefore present unnatural ROA values. Finally, each observation is the average value of the corresponding index by specified financial year whereas negative values are red-coloured. The tables present a comparison of EU and US Aerospace and Defence sector, considering the UK exit case as well (European Union*).

2.1. Financial Performance

Industry/Index	Mkt_Cap	EBITDA	Adj_EBITDA	ROE (%)	Adj_ROE (%)
US	17881.26	1709.01	2377.73	27.80	33.26
EU	14227.02	1446.13	1518.74	-3.95	13.00
EU*	15420.98	1655.32	1483.48	14.01	13.20

Table 4 – Defence industry average financial performance (2016)

As for 2016, there is no doubt that the United States Aerospace and Defence sector performed better for all the considered indexes. As already mentioned, Mkt_Cap, EBITDA and Adj_EBITDA values are expressed in US million dollars. According to Bloomberg's definition, the Mkt_Cap is the monetary value of all outstanding shares stated in the pricing currency and peaks at an average of roughly 18 billion dollars for the US defence industry (Table 4). The EBITDA presents the same pattern even though the gap between EU and US defence companies is some slightly less pronounced; however, its adjusted value while re-establishing a net positive contribution of the UK to the overall European performance, it contributes to widen the gap to about 1 billion US dollars. In 2016, the EU ROE has been the only negative value and it appears to be driven mainly by the UK firms. ROE measure a corporate's profitability by revealing how much profit a company generates with the money shareholders have invested, in percentage. It should also be reminded that according to some experts – i.e. Lang Davison, the former executive director of the Deloitte Centre for the Edge, among others - ROE is not a reliable figure for the performance assessment of a firm, sometimes hiding real problems through artificial financial strategies: for, other indexes such as ROA have to be preferred and are much more indicative of the long-term conduct²⁸. Moreover, the adjusted ROE figure

Industry/Index	Mkt_Cap	EBITDA	Adj_EBITDA	ROE	Adj_ROE
US	11.48	8.31	6.51	-48.26	-53.96
EU	2.46	-14.25	-20.57	L	-13.76
EU*	4.62	1.25	-23.76	25.31	0.63

Table 5 – Defence industry average financial performance, growth rate (2015-2106)

²⁸ Hagel III, J. et al. (2010), *The Best Way to Measure Company Performance* (online), Available at: <https://hbr.org/2010/03/the-best-way-to-measure-compan> (Accessed 10 October 2017)

(Adj_ROE) show a way more reassuring trend with EU values around 13%.

Table 5 shows the growth rate term by index and industry for the 2015-2016 financial years. Since the computed growth rate for negative values might produce misleading results, following an old notation from the Wall Street Journal, if the value of the latest period was negative against a positive year-ago observation, then a red “L” will be displayed; on the contrary, if the value of the latest period was positive against a year-ago negative observation a “P” will figure²⁹. Interestingly, for Mkt_Cap, EBITDA and Adj_EBITDA growth values, the US industry average is far above the European scenarios; on the contrary, for ROE and its corrected value (Adj_ROE) observations the US companies appears to be worse off. The UK appears to be an important determinant in the European score: in particular, as regards to Mkt_Cap and EBITDA, it seems that the EU scenario without the UK is positively biased by some top performing firms, even though the Adj_EBITDA observation slightly contradicts the main trend. Finally, as already revealed by Table 4, UK companies are substantively dampening the ROE and its adjusted value performance: the EU no-UK scenario presents the only values that outperform the US ones. Overall, notwithstanding some positive trends, the European Union is far from being competitive on a pure financial performance base as the US dominance is still uncontested.

2.2. Efficiency and Productivity

Industry/Index	WACC_ROIC	Sales_TA	ROA (%)	Adj_ROA (%)
US	-5.55	0.81	-45.25	6.31
EU	3.15	0.66	-0.14	3.22
EU*	7.68	0.67	3.32	3.51

Table 6 – Defence industry average efficiency and productivity indicators (2016)

Efficiency and productivity have been operationalized in terms of Returns on Invested Capital (WACC_ROIC), Sales over Total Assets (Sales_TA) and Returns on Assets (ROA). WACC_ROIC is calculated as Net Operating Profits after Taxes divided by Total Invested Capital: it is mainly a measure of how efficiently the capital invested is used. On the other hands, Sales_TA and ROA can be used as proxy of the productivity levels of a company and therefore of the industry: Sales_TA

²⁹ See WSJ, <http://www.wsj.com/public/resources/documents/doe-help.htm#netincome>

represents the amount of sales or revenues generated per dollar of assets, while ROA is computed as Trailing 12 Months Net Income divided by average total assets. In 2016, European companies have on average employed their resources more efficiently than the American ones: the US WACC_ROIC value being only -5.55 against a positive European and European Union* score of 3.15 and 7.68 respectively. While as of Sales_TA the US superiority is reaffirmed, the ROA value is the worst score recorded for US companies in 2016 against a European Union average of -0.14 and 3.32 for the UK and non-UK scenarios respectively. However, as far as this latter case is concerned, the Adj_ROA values of US companies are nearly as twice as both the EU cases. Perhaps, it is the ROA corrected value that should be taken into consideration; in fact, since 2008 the Adj_ROA has a total reversed and positive trend with respect to the pure ROA actual value as the two graphs below show: some companies are permanently and abnormally recording negative values and as such are not highly representative of the US aerospace and defence industry population (Fig. 6 and Fig.7).

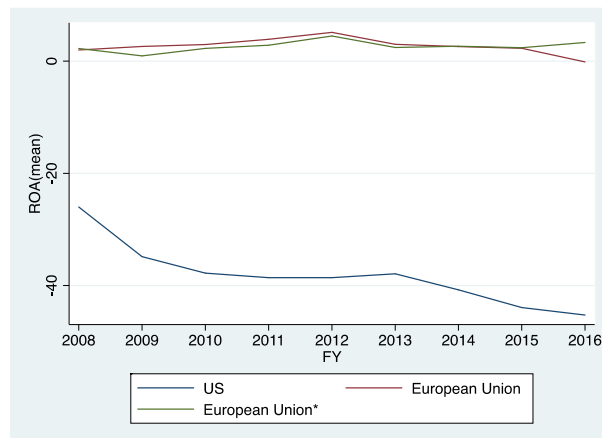


Figure 6 – ROA values (2008-2016)

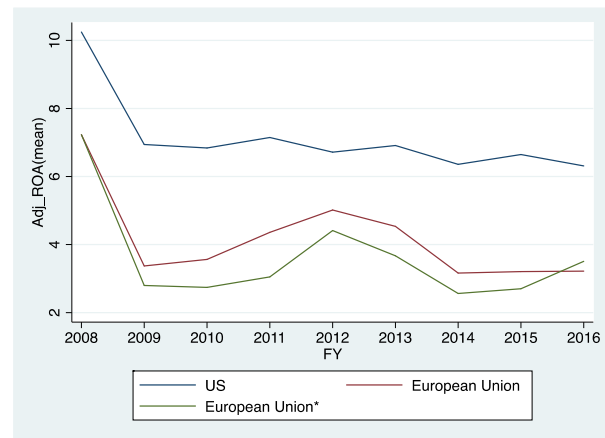


Figure 7 – Adj_ROA values (2008-2016)

It is interesting to notice that the UK is significantly dampening the overall EU performance, especially as it comes to WACC_ROIC and ROA. Moreover, as it was the case for ROE in the previous paragraph, the only European negative value for the 2016 efficiency and productivity levels is caused by the bad performance of UK firms (European Union, ROA= -0.14).

It is not easy to comment Table 7 which shows the growth rate for efficiency and productivity levels between 2015 and 2016 financial year. First, as of WACC_ROIC and Adj_ROA the US industries scored lower levels of growth rate with respect to European firms. This is a good signal, even though we should be cautious since Sales_TA and ROA trends are more contradictory. Even as it comes for role of UK defence sector for the overall European performance, the results are more

Industry/Index	WACC_ROIC	Sales_TA	ROA (%)	Adj_ROA (%)
US	-11.63	-2.31	-3.02	-5.04
EU	0.00	-3.98	L	0.34
EU*	0.00	-5.34	38.31	29.86

Table 7 - Defence industry average efficiency and productivity indicators, growth rate (2015 - 2016)

ambiguous: beyond the WACC_ROIC and Sales_TA UK positive net contribution, ROA and Adj_ROA values are far better off in the non-UK EU scenario. Overall, comparing Table 6 and 7, it is possible to say that beyond the clear US superiority, there are some positive signs of a EU low recovery. However, these results should be interpreted? Are we in the presence of a long-run trend or it is a rather temporary pattern? What should we assume from the 2015-2016 growth trends we computed so far? To answer these questions, let us compare the situation of US and European defence industries by major financial, efficiency and productivity indexes as far as 10 years earlier.

2.3. Long-Run Comparison

Industry/Index	Mkt_Cap	EBITDA	ROE (%)	WACC_ROIC	Sales_TA	ROA (%)
EU	267.29	174.91	P	L	-60.04	8.67
EU*	10.32	-73.66	3507.85	-103.16	-65.54	2.27

Table 8 – Defence industry average indicators, delta growth rate (2006-2016)

Table 8 is built on the growth rate of the difference between the EU and US value by index between 2006 and 2016. For instance, the Mkt_Cap of European Union (110,75) is computed as the difference between the Mkt_Cap of US industry and the Mkt_Cap of EU industry in 2016 subtracted by the difference between the Mkt_Cap of US industry and the Mkt_Cap of EU industry in 2006, divided by the latter value and shown in percentage terms. In this sense, Table 8 shows the long run trends as it comes to major performance indexes affecting the European aerospace and defence industries with respect to the US one. Here, negative values indicate a positive European score, meaning that the gap has been reduced over the period considered. We have already shown that as of 2016, the EU companies have not been able to catch up on average with the US ones. However, did the European firms recover some of the gap in the last ten years?

Interestingly, the results shown in Table 8 seem to confirm some of the expectations of the previous paragraphs. As far as the financial performance indicators are concerned, the US superiority is evident for Mkt_Cap values, even though the EU non-UK EBITDA value has significantly recovered the gap in the past ten years. Moreover, as already reported in the 2015-2016 analysis, the UK appears to dampen the overall European performance. In addition, as far as productivity and efficiency measures are concerned, the conclusions we draw for the short-run analysis of table 7 are also confirmed in a larger time-span. It seems that European firms are hastily recovering in terms of Sales_TA and WACC_ROIC values, whereas the figures for ROA are more contradictory as of the overall efficiency and productivity performance. On balance, while the difference between the US and EU financial performance has overall widened, the short-run positive growth trends result to be verified and strengthened in a long-run perspective for the second group variables.

2.4. Conclusions

Overall, it appears that the performance analysis has confirmed the expectations and hypothesis which have been formulated in the last section. In fact, the quality differences seem to be reflected in the different performance of European and US firms. The superiority of American defence sector is net also at the firm level, being possible to confirm in the long-run the positive short-term observations that have been found for efficiency and productivity indicators. As will be shown in the next section, productivity and efficiency growth are the main responsible and the necessary premises of the overall industrial development. At the same time, it should be recalled the big limits of the analysis that has been conducted. Mainly because of the lack of data available it has not been possible to disentangle the difference between military and civil activities. It is in companies' interests not to publish detailed data on their accounts in order to proceed with transfer pricing practices. Moreover, the variable that have been used to assess the performance cannot be exhaustive and it should be remembered that there is no single index to assess the performance of an industry; however, for the purposes of this analysis the chosen indexes provide nonetheless an accurate assessment of the different strength and weaknesses of European and US aerospace and defence sectors.

3. Structure: Economies of Scale and Scope

On Monday the 13th of November 2017, Federica Mogherini the High Representative of Foreign Affairs and Security Policy received a notification letter from 23 member states expressing their will to cooperate in defence matters and finally give substance to the Lisbon Treaty provisions concerning the Permanent Structured Cooperation (PESCO)³⁰. As reported by Mogherini in an interview released right before the top-level meeting, the problem of European defence is not that it does not spend enough but that it spends in a fragmented way. According to the High Representative, PESCO developments in subjects such as capabilities or operations will allow the European Union “to exploit its existing economies of scales”³¹.

It is not the first time a distinguished civil servant expresses herself in this way. The main objective of this paragraph is to highlight what is the reasoning which lies behind Mogherini’s statements. Why does she mean that capabilities developments should create economies of scales? How do economies of scales work and what is their contribution to the overall European defence industrial competitiveness? Eventually, why could this day represent “an historic moment”³²?

Economic theory provides evidences of some industries being able to avoid (natural monopoly) or push forward the output threshold where firms face diminishing marginal returns. Normally, for given quantity of inputs – notably land, capital and labour– the production of a company reaches a point where average total cost per unit (ATC) equal marginal costs. This is the optimal quantity that minimize the cost function, also called break-even point (in the short-run) or minimum efficient scale (*mes*, in the long-run). For instance, in order to produce, a company might need an initial investment in a special machinery which reaches its maximum efficiency with ten workers: for any added operator below the tenth unit, the production is facing decreasing or constant marginal costs. If the firm decides to hire the eleventh employee, the production faces decreasing marginal returns (as for the decreasing productivity, the marginal costs are increasing). The output, though marginally decreasing, is still rising. The firm will continue to produce as far as its marginal costs meet the average total costs.

³⁰ Airpress (2017), *Difesa UE, tutti i dettagli sulla firma della PESCO* (online), Accessible at: <http://formiche.net/2017/11/13/pesco-difesa-ue/> (Accessed 15 November 2017)

³¹ Mogherini, F. (2017) *online interview* Accessible at: <https://www.youtube.com/watch?v=0I8jtTbR2WM> (Accessed 14 November 2017)

³² Ibid.

To keep the same efficiency while increasing its production, the firm might decide to invest in an extra machine. Assuming the productivity and price of the latter investment to be equal to the initial one, the quantity which minimize the ATC function is farther on the output axis. Equally, given the same combination, price and productivity levels of production factors, for differing amounts of initial resources and fixed costs, firms diverge only in terms of their production capacity: the higher the investment, the higher the output needed to recover the fixed costs and the point where marginal costs equal ATC³³. However, so far, bigger output does not imply lower prices: the causality link does not run directly from higher concentration of resources to better performance.

As the US defence firms are performing better compared to European ones, the European defence technological industrial base is lagging behind in terms of competitiveness. We define here competitiveness as the capacity to deliver products at lower unit price and/or higher quality. Quality, as already shown, can sum up elements such as marketing and advertising. Both price and quality are incentives to consumers' purchasing will and demand catalysts. In the first chapter, it has been already highlighted that competitiveness is the main reason of the diverging performance of defence industries across the Atlantic: in fact, costs and quality differences for products make it possible to prompt demand, foreclose competition and charge a mark-up for unit product sold. However, what does enhance the firms' competitiveness? How could European firms be able to catch up with the American companies' performance levels?

At first, input prices might differ across firms or along time. Notwithstanding the difficulty to find differences in production factors prices within a given country (since it is usually a cross-country pattern), business strategies of vertical integration are competitive enhancers through transfer price practices or anti-competitive behaviours that lower significantly the costs of inputs while they might be sued by anti-trust authorities. For sake of clarity, we will leave these latter considerations and the analysis of these strategies to further and future insights.

³³ It worth noticing two implications. First, beyond a certain output threshold, the initial investment cannot be considered a fixed cost anymore: in fact, to keep the same efficiency (the same price level of $MC=ATC$) while increasing the quantity produced, the firm needs to acquire new machineries. For, the number of these inputs depends on the quantity produced - in the long run all costs are variable. However, there are some costs that can be considered as purely fix; R&D costs are an example of pure fixed costs, even in the long-run. At the same time, new investments are reasonable if it is possible to deliver the necessary output which maximises the production function. For, not only it is necessary to investigate whether there is still room for market opportunities and demand improvements, but it is also vital to overcome possible production constraints: for instance, there might be a labour force shortage that dampen the possibility to fully exploit the new investment maximum efficiency point. Respectively, the output demand and supply are both feasibility condition to improve the production.

The second element that plays a key role as for the firm's competitiveness is the efficiency of the production factors, notably their productivity. In the last section of the first chapter it has been shown that the European defence industry has recorded productivity improvements: even though the overall financial performance is far from equal the American one, a strong and sustainable productivity is the necessary premise to competitiveness' enhancements. The performance of a given set of inputs (i.e. their productivity) depends both on the quantity combination of the inputs and on the efficiency of each resource employed. First, to fully exploit production factors capabilities, some quantities of inputs are needed. In the above-mentioned example, the machinery would operate below its optimal point in case of a shortage of labour force. The lack of available resources in the agricultural sector is among the main reasons of the EU Common Agricultural Policy (CAP). Beyond differing costs of input prices, the competitiveness differential of European and Latin American or Asian agricultural products is given by differences in inputs exploitation capacity³⁴. In fact, it is widely recognised that compared to other countries, the farming industry of European member states is mainly composed by small family-run companies with narrow land endowments (reportedly, in Italy Melinda is a consortium of four thousand families producing apples established to overcome this major structural problem). However, as already shown, the difference in the amount of initial resources is not sufficient to reason in terms of productivity improvements: even though farmers in some countries have greater initial land endowments, the return in terms of products per hectare might not be different to the European case. The problem lies as European farmers are not able to maximise the yield of some inputs. Notably, agricultural machineries - such as tractors – might be able to operate efficiently over larger territories, without increasing marginal costs. For, the costs of the tractors might be spread over a greater output and lower the unit price. It is necessary that the productivity of tractors is not decreasing over larger inputs of land. Accordingly, narrower initial endowments dampen the possibility to fully exploit efficiency of production factors.

Second, productivity improvements might arise as well from differences in production factors efficiency of the same input. For a given set of inputs, some firms might be able to produce a higher quantity of the same product at the ATC minimum. For example, if we consider the case of two firms A and B producing clothes with labour as the only production factor, it might be the case that for the same quantity of labour (e.g. 8 hours), B produces a bigger quantity and/or better quality of clothes. The reason of this difference is explained by the efficiency of B's workers compared to A's. For, in

³⁴ Defraigne, Jean-Christophe (2013), *Introduction à l'économie européenne*, De Boeck Supérieur, Bruxelles.

this example, the human capital is the competitive enhancer of the firm's performance: *the cost* of the input (labour) is spread over a greater output and therefore the unit price of the single product is lower. Equally, productivity improvements could take the form of quality amelioration: increasing the quality make it possible to charge a mark-up and extract a rent over the unit product sold.

At this point, the question arises as to whether it is possible to control the individual and/or combined efficiency of the production factors. The previous example shows a situation where, given the same initial endowments, the resources efficiency differential is randomly assigned to B. In the real economy, businesses invest in order to improve their productivity levels. Following up to the previous case, A could have either hired higher qualified labour-force or invested in more sophisticated machineries, respectively at increasing unit variable and fixed costs, in order to catch up with B's performance. It is the return of the different production factors and their combination that decides for the right balance between substitution and complementarity of initial resources: the trade-off evolves along time because of technological and human progress and across industries – e.g. the agriculture sector requires a different input combination compared to high-technological intensive sectors such as the automotive industry.

Moreover, the possibilities to exploit productivity improvements greatly differ across industries. Accordingly, for higher possibilities to enhance the productivity, higher fixed costs have to be faced. For example, efficiency improvements in the cultivation process of agricultural products are far less consistent than those that might be achieved in the aerospace and defence industry. The main reason regards the nature of the sector and the products sold. Certainly, tractors and the use of pesticides to improve agricultural fecundity boost the overall productivity; however, capital investments in farming face earlier decreasing marginal returns compared to other industries. Beyond a certain threshold of investments in agricultural machines and/or qualified labour force, it is difficult for agricultural products to significantly lower their unit price or improve their quality. Reportedly, the quality improvements of fruits along 60 years cannot be compared with the quality improvements of next fighter generations. On the contrary, sectors such as defence where the possibilities of productivity enhancements are high, if not limitless, present high fixed costs and, consequently, a more concentrated market structure (see below). Differing opportunities to improve the productivity derive from varying relative intensity of the production factors across industries. Not just the intensity of the sector itself, but the nature of the input intensively employed in that sector explains the difference: according to their characteristics (that might belong to the object itself or being the

consequence of historical and social or geographical developments³⁵), resources are subject to return constraints. For, sectors that are capital intensive have usually more opportunities of efficiency improvements since technological progress is a main driver of productivity gains; on the other hand, labour-intensive sectors struggle to find ways to perform better and they often face reconversion hurdles. In fact, it is more difficult to increase the labour-force profitability, rather than modernizing the industry and lowering the labour-capital ratio. Human capabilities have a margin improvement far smaller compared to the ever-limits-overriding technological progress.

To conclude, in order to enhance their overall competitiveness, firms face high fixed costs either to lower their marginal costs or to improve the quality of the product. However, the higher the initial costs, the higher the optimal quantity to recover them and remain competitive in the market. Economies of scale are cost advantages that rise from increasing the output and can be either internal to the firm or belong to a cluster of regionally concentrated companies³⁶. These economies face increasing or constant returns until the minimum efficient scale is met. Consequently, *mes* determines the number of firms in the market – e.g. natural monopolies arise when fixed costs are as high as the market demand is not sufficient to reach the maximum efficiency. To avoid output demand limitations and reach the efficient scale, sometimes, it is possible for few margin improvements of fixed costs to widen the scope of the products sold and access new markets. This business strategy aims at the creation of the so-called economies of scope; for, in order to reach the optimal quantity to cut the high fixed costs, firms differentiate their production in several markets and produce different products that have similar initial fixed costs³⁷.

From the previous analysis, it is possible to argue that the causality link runs from productivity improvements to better performance; whereas just positive correlation can be found for the relationship between high concentration and efficiency gains: not all the investments effectively boost the productivity. However, it is possible to draw some important conclusions as of the necessary conditions to fully exploit economies of scales and scope:

³⁵ Pomeranz, K. (2001), *The Great Divergence. China, Europe and the Making of the Modern World Economy*, Princeton University Press, Princeton, New Jersey (U.S.)

³⁶ Defraigne, Jean-Christophe (2013), *Introduction à l'économie européenne*, De Boeck Supérieur, Bruxelles.

³⁷ Chandler, A. (1990), *Scale and Scope : the dynamic of industrial capitalism*, Harvard University Press, Cambridge Mass. (U.S.)

- In order to improve the efficiency, it is necessary – even though not sufficient – to make initial investments: not all investments target productivity enhancer factors, sometimes being able only to push forward the efficient production point without price or quality improvements. According to different marginal returns, the optimal entity of the initial fixed costs differs across industries and along time but not across firms for the same sector, keeping constant all the other elements.
- Firms should be able to deliver the necessary output to cut the initial fixed costs either intensively increasing the quantity of a given product or extensively widening their scope. In this sense, it is important for firms not to incur in input shortage problems as they might dampen the overall production efficiency.
- It is necessary for the firm optimal output to be demanded on the market in order to operate at its efficient scale point.

Economic literature has already widely proven the significant economies of scale running in the defence industry. For instance, Professor Hartley found cost reductions around 10 per cent when output is doubled in some Western Europe and North America industry studies³⁸. In the following section, we will shed some lights over the structural problems of European defence firms from a supply and demand side standpoint. Our hypothesis is that the structural issues lie at the core of the lack to fully exploit European economies of scale and of the divergent performance of defence industries across the Atlantic.

In the first chapter the conduct and performance of European defence firms have been analysed. It has been shown that European products are lagging behind US military systems both in terms of quality and export performance. The European lack of competitiveness dampens the firms' performance and pose major threats in terms of industrial survivability and military-strategic independence of European States. Moreover, it has been argued in favour of quality amelioration and lower unit prices running from productivity improvements. It is high time to show the main structural shortcomings that explain efficiency losses and whether there are opportunities to overcome these limits.

³⁸ Hartley, K. (1991) *The Economics of Defence Policy*, Brassey's (U.K.).

3.1. Supply-side Analysis

As far as production is concerned, the previous paragraph highlighted the positive correlation that runs from high fixed costs to productivity gains. It has been argued that it is not possible to determine any causality since not all the initial investments accomplish an efficiency objective. Usually, in the long run - particularly for the defence sector - R&D expenditures are considered the most important fixed costs that any military company have to face: these are pure fixed costs in the sense that they do not present an output threshold where their return starts to decrease. However, in order to remain competitive and keep offering better products, firms keep investing in R&D expenses, fearing demand shortages and so be foreclosed from the market. Moreover, because of the huge quantity of these initial costs, it is barely impossible to recover them whence the natural monopoly status is often addressed for national defence sector. In addition, it has been shown that in order to take full advantages of the economies of scale, it is necessary that no input shortage arises. For, the size of a company is a reliable proxy as it come to its capability to exploit the R&D investments. Eventually, both R&D and size will be compared for the European and US defence industrial base as their interaction is the fundamental explanatory variable for the supply efficiency. In the last section of this paragraph, it will be also addressed the scope issue. As it has been already exposed, in order to override lack demand-related problems, businesses tend to differentiate their production and enter new markets for few higher costs. For comparability sake, the sample chosen for this analysis is equal to the one used for the analysis on performance.

3.1.1. Total Assets

Industry/Index	Tot_Assets
United States	14819.01
European Union	21773.91
European Union*	23493.67

Table 9 - Total Assets (2016)

Industry/Index	Tot_Assets(%)
United States	2.78
European Union	0.16
European Union*	2.02

Table 10 - Total Assets, growth rate(2015-2016)

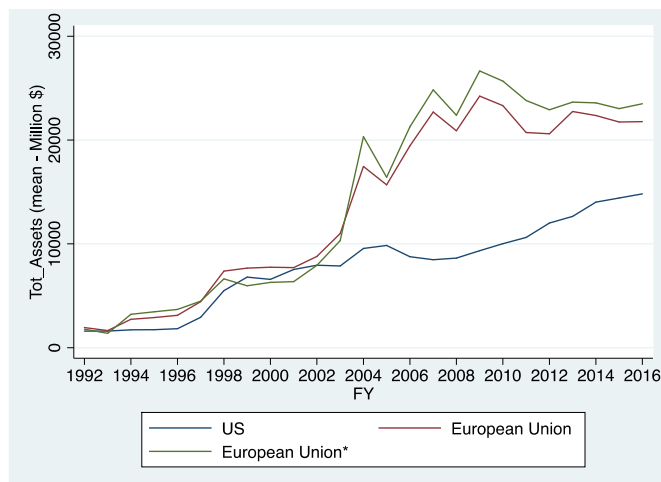


Figure 8 – Tot_Assets (1992-2016)

First of all, it might be interesting to check the Total Assets (Tot_Assets) value of American and European firms. Tot_Assets are the value of all short and long-term assets as reported on the company's Balance Sheet. As it was in the performance analysis, the measure is the average value of the observations in the sample. Moreover, Tot_Assets can roughly sum up the R&D and size elements and provide

a first general assessment of European and American supply structure. Values in Table 9 and 10 are reported in US million dollars.

In terms of Total Assets, it appears that in both scenarios the European defence industry is far better equipped than the US one. Particularly, in the non-UK case, Tot_Assets peaks at more than 23 against only about 15 billion dollars for the US. This is the first surprising result. In fact, as it has been argued so far, the lack of competitiveness of the European industries should be primarily reflected in the different structure of the defence industry across the Atlantic; for, the higher the investments in R&D and the size of the industry, the higher the possibility to fully exploit economies of scales. However, the 2016 Tot_Assets seems to contradict this general hypothesis. Furthermore, Figure 8 shows that the 2016 outcome is not a lucky temporary result, rather the point of a broader trend whose begin dates back to FY 2002. As remarked by Table 10, the United States are slowly recovering the gap but this pattern remains still a minor element in the overall US weakness. On balance, as far as supply features are concerned, it is necessary to dig and deepen the analysis: while being a first-hand indicator, Tot_Assets is a rather general measure yet; for, the contradictory considerations we draw so far recommend to decompose the variable chosen in its sub-elements, in order to gain in accuracy.

3.1.2. R&D and Intangible Assets

Industry/Index	R&D	Int_Assets
United States	492.74	6604.20
European Union	892.31	4979.13
European Union*	897.96	4271.78

Table 11 – R&D expenses and Int_Assets (2016)

Industry/Index	R&D(%)	Int_Assets(%)
United States	19,44	8,14
European Union	0,34	-8,71
European Union*	0,70	-8,13

Table 12 – R&D expenses and Int_Assets growth (2015-2016)

Table 11 shows the amount of R&D expenses and Intangible Assets (Int_Assets) in million dollars. Total R&D costs include R&D in profit and loss account and capitalized R&D during the period considered (i.e. FY-2016 in Table 11). Surprisingly, on an aggregate level, the US is spending nearly half of the European Union Research and Development costs in the defence sector. Furthermore, as it was for Tot_Assets, the US-EU R&D costs started to diverge in the early 2000s whereas the gap has widened in the past ten years (Fig. 9). Even though the 2015-2016 R&D growth term record a positive US performance, it is too early to talk about a US recovering, the gap being still massive. At this point, it should be reminded that even though they are positive correlated, there is no straight causal link between high investments and productivity improvements: not all investments are able to improve the production efficiency. For, the Intangible Assets indicator should be preferred as a more accurate measure which highlights the different success of the investments in innovation. According to Bloomberg, the Intangible Assets value (Int_Assets) includes also patents, copyrights, capitalized development costs and software and property rights³⁹. As far as Int_Assets is concerned, the US defence industry lead uncontested. In 2016, the US gauge a 6.6 billion dollars' threshold against 4.9 and 4.2 billion dollars for the EU UK and non-UK scenarios respectively. Even though in percentage

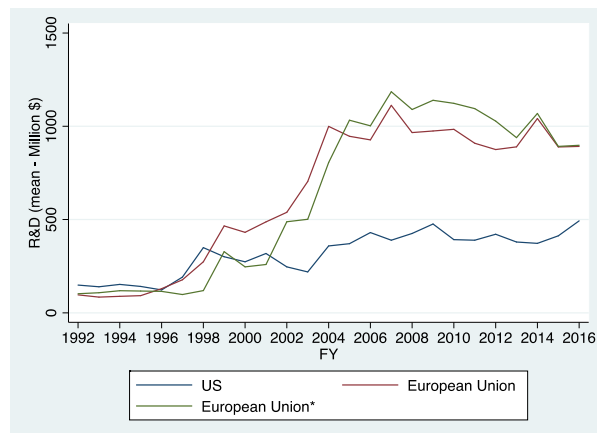


Figure 9 – R&D expenses (1992-2016)

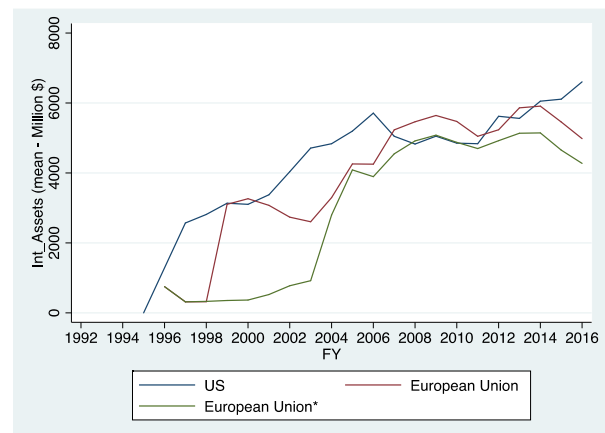


Figure 10 – Int_Assets (1992-2016)

³⁹ According to Bloomberg's definition, Intangible Assets is "The total amount of Intangible Assets as disclosed in the financial reports. This amount is included as a portion of Other Long-term assets. Intangible assets include goodwill, patents, copyrights, trademarks, trade names, organization costs, capitalized development costs and software, franchises, licenses, property rights, core deposit intangibles (banks), and intangible portion of prepaid pensions."

term the US-EU Int_Assets gap is not as large as the former EU-US R&D difference, the absolute value is much higher for Int_Assets (Table 11): respectively, the US R&D being some 400 million dollars less than the EU ones, while the US Int_Assets scoring as nearly as 2 billion dollars more than the EU Int_Assets. Figures for the EU non-UK scenario are pretty similar. Only with the UK participation, the European Union has been able to outperform the United States in some years – notably, around the financial crisis’ peak. However, a couple of important remarks should be kept in mind. First, since 2014 the United States regained their dominant position in Int_Assets scores and appear to keep growing as confirmed by the 2015-2016 growth rate (Table 12). On the contrary, in the past two years, the European Union performance has dampened and sharply decreased. Second, since many companies incurred in several important costs adjustments to keep the competitive edge, the crisis’ period performance is not representative of the overall trend. Keeping in mind this latter remark and beyond the sharp EU recovery of the early 2000s, the US dominance supremacy as regards to Int_Assets is safely confirmed also in a long-run perspective. On balance, even though spending far less in R&D costs, the US investments appears to be far more effective increasing their innovation level.

3.1.3. *Employment and Tangible Assets*

Industry/Index	Tang_Assets	N_empl
United States	11919.36	33560.24
European Union	18468.31	39963.77
European Union*	21830.31	41250.22

Table 13 – Tangible Assets and Number of Employees (2016)

Intangible Assets is the first sub-element of the Total Assets value that we analysed. Furthermore, Int_Assets, coupled with R&D expenses provide a clear overview on the EU-US investments differential and their effectiveness. We should recall that, in

order to fully exploit economies of scales, it is necessary for the companies not to incur in any input shortage or production constraint which in turn could seriously dampen the scale of output created while preventing to recover the initial fixed costs. Therefore, under a supply standpoint and beyond the R&D/Int_Assets focus, it is also necessary to study the size of the defence industries. Table 13 operationalizes the dimension of the industry in terms of Tangible Assets (Tang_Assets) and Number of Employees (N_empl). Accordingly, Tang_Assets are computed as Tot_Assets minus Int_Assets

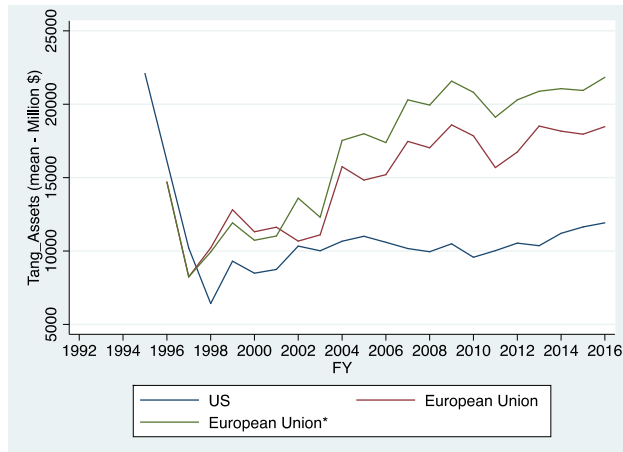


Figure 11 – Tang_Assets (1992-2016)

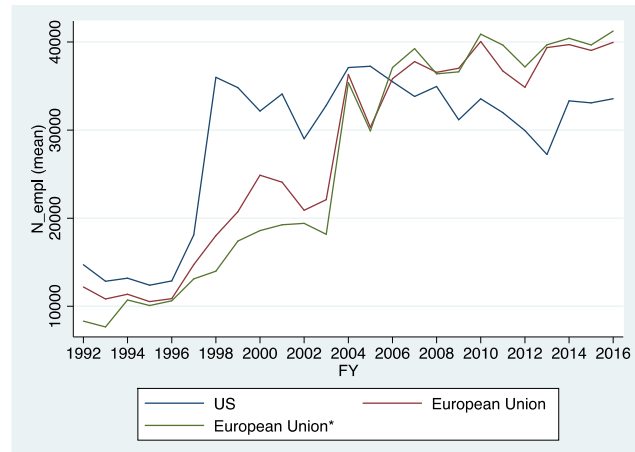


Figure 10 – N_empl (1992-2016)

and figures are reported in million dollars. Data reported in previous tables (Table 9 and Table 11) might differ from the observations in Table 13 since Tot_Assets present less missing values compared to Int_Assets and Tang_Assets indicators. As in the previous cases, observations refer to the industry average computed on the reference FY. Once again unexpectedly, since 1998 the Tang_Assets value of the EU is higher with respect to the US one for both the scenarios (Figure 11). Moreover, the gap has been widened in the past 20 years reaching a 6.5 and 9.9 billion dollars difference in 2016 for the EU and EU* scenarios respectively (Table 13). The 2015-2016 Tang_Assets growth term has not been added to the analysis, not providing any meaningful additional element beyond a positive and similar pace growth term for all the defence industries considered. Similarly, as far as the Number of Employees are concerned, the European Union defence sector is clearly larger than the US on an aggregate level (Table 13). As early as 2005, the US used to dominate in terms of number of employees. However, in the past decade while the US N_empl value has generally levelled out, the EU has been able to catch up and even overtake the average American company size. Perhaps, these trends indicate that while the US firms have been able to reach their minimum size to keep the necessary efficiency, the EU companies and their member states have engaged in an important wave of mergers and acquisitions (M&A), in order to keep the pace with the increased international competitiveness. In fact, all the graphs that have been presented so far prove the early 2000s to be a turning point in terms of an increased European competitiveness. For all the described values, the growth pace of the 1990s records a sharp thrust in the first years of the new millennium.

3.1.4. Scope

From a supply-side standpoint, there is a third important structural element to be assessed: the scope of the products by company. So far, it has been argued as regards to the important high fixed costs running in the defence sector as well as to the minimum efficient size necessary to override inputs shortages problems and recover the initial investments. It has been shown that beyond a clear US superiority in Intangible Assets values, the EU defence industry has overall been able to catch up the American military sector in terms of size and investments. However, while endowments and investments are necessary, they are not sufficient for a company to meet the minimum efficient scale. For, the optimal output produced needs to meet an equal demand. If the market the firms is operating in is too narrow to meet the *mes* condition, it is often the case for businesses to find different demand-sources, penetrating more markets. In fact, in some cases, it is possible to widen the scope of production for some small increment of initial investments. Accordingly, this business strategy is feasible and sustainable in the long run as long as the costs to enter new markets do not exceed their benefits. Building on the Top-100 firms of the 2012 SIPRI Yearbook, we selected the top-10 EU and US military companies, ranked by arms sales. Once again, subsidiaries have been excluded since the sector the affiliate is operating in is already included in the parent's accounts – e.g. MBDA is the missiles section of BAE Systems and Leonardo (former Finmeccanica). Data refer to 2011 and are reported for a complete and detailed description in Appendix II. Since the US defence industry is on average performing better compared to the EU, we would expect the top-10 US firms to present a wider scope of their products. Surprisingly, the European average is some 0.5 above the US one as of number of operating sectors. This latter result is even more striking if we compare the first EU and US military companies: Lockheed Martin sell its products in only 4 military sectors against 7 for BAE Systems. How could we explain this counter-intuitive pattern? In fact, it seems that US firms have been able to reach the minimum efficient scale without going for scope widening strategies. At the same time, how is it possible for the US defence firms to record higher levels of performance and being able to better exploit existing economies of scale while the average size and investment level do not differ significantly and the scope is even lower compared to the EU? Perhaps, we should widen our analysis and consider other structural elements. The US Department of Defence (DoD) budget accounts for the largest military buyer in the world. Consequently, the US military companies can easily outperform other firms in terms of output sold: it might be the case for these firms to benefit from commands as large as they do not need to penetrate new markets in order to fully exploit their

economies of scale and reach the *mes* threshold. However, it might be argued that it is not possible to causally address the large DoD procurements as the main reason of the smaller scope of US companies. Even though these critics might be welcomed, later in the analysis it will be presented some patterns running from a demand perspective and being able to support previous statements with some significant empirics. Moreover, the American advantage is also proven by some investments strategies of main European firms who decided to enter the highly-protected US market in the past 20 years; the most notorious example being BAE Systems which expressly decided to target the US defence market with its American subsidiary. Before moving to a demand standpoint study, it worth conclude the supply analysis through a quick analysis of the M&As wave recorded by EU and US firms over the last decades.

3.1.5. M&As

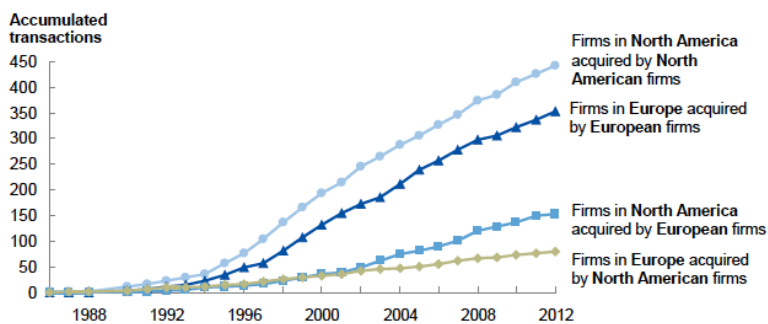


Figure 12 – Acquisitions of defence firms in the US and Europe (1988-2012), Source: McKinsey, 2013

consolidation that took place since 1988 in terms of accumulated transactions and specifications of the domicile of the buyer company – whether European or American. First of all, in the past decade the EU have been able to catch up, the historical trend revealing the US superiority in terms of transactions. In particular, the European growth appears to be driven foremost by an acceleration of cross-Atlantic investments. This pattern seems to confirm some of the hypothesis stated in the last section: first, European companies have tried to penetrate the American market which has proved to be a far more growing market in the past decade⁴⁰; second, in the early 2000s, the European cross-Atlantic activity has nearly doubled compared to a more modest US trend. These two considerations look like to confirm some of the patterns that have been studied as regards to EDITB analysis. For,

In order to explain major changes in the pace of most supply structural indicators since the early 2000s as well as to confront some hypothesis concerning the investments strategies of European firms across the Atlantic, it is necessary to analyse the main M&As processes over the past 20 years. Figure 13 shows the

⁴⁰ McKinsey, (2013) *The Future of European Defence: Tackling the Productivity Challenge*, McKinsey & Company

the consolidation of the early 2000s might explain some of the improvements of all the indicators studied as regards to production such as total assets, number of employees, R&D expenses and so on. However, since the level of transactions for the US and Europe is roughly the same, with Europe slightly lagging behind, it is not possible to understand why the EU have been able to outperform the US defence sector as for all the indicators except intangible assets. In this sense, it might be interesting to investigate the value of the European investments and compare it with the US, rather than the number of transactions itself. In fact, in the first years of the new millennium it took place the rise of some important European champions such as EADS (2000), BAE Systems (1999) or MBDA (2001). This latter consideration paved the way to further analysis that have not been undertaken in this study due to difficulty in finding relevant material.

3.2. Demand-side analysis

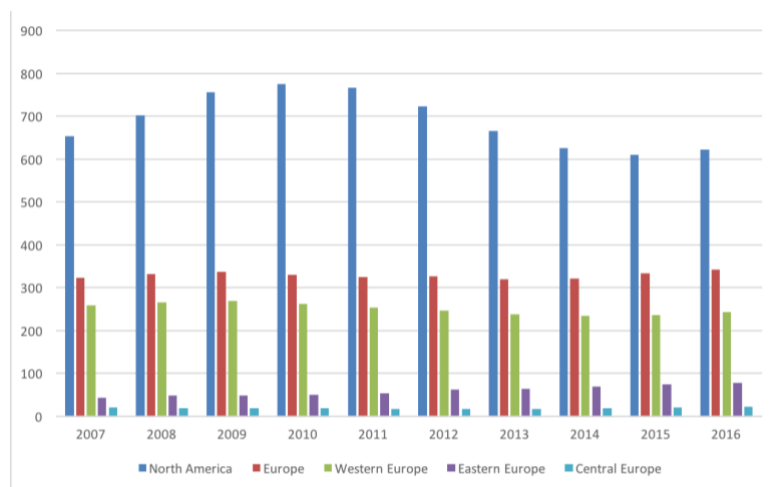


Figure 13 – Military expenditures by main regions (2007-2016)

The first section of the current chapter addressed the demand as the other most important element towards the full exploitation of efficiencies derived from the creation of economies of scale. It has been argued that the output does not have only to be produced but also requested on the market. For, the higher the output scale, the higher the possibility to

recover the initial high fixed costs. It is widely known that the United States military spending are the highest in the world. Figure 14 compares the North America and European military spending over the past ten years. Data have been sourced from SIPRI database on military spending and are displayed in billion dollars. Moreover, the regions considered take into account a wider scope: North America accounts for Canada and the United States (about 95% of North America total military spending), while Europe does not include EU countries only⁴¹. Even though less accurate in terms of comparability with the previous analysis, the broad picture arises clearly: North America is clearly spending more compared to European countries over the period considered. Furthermore, it might be

⁴¹ For a full specification see <https://www.sipri.org/databases/regional-coverage>

interesting to breakdown military expenditures by major defence categories. In fact, for the purposes of our analysis, it should be stressed the different spending as regards to procurement and acquisitions rather than other defence budget section. Interestingly, a table downloaded from the final report of

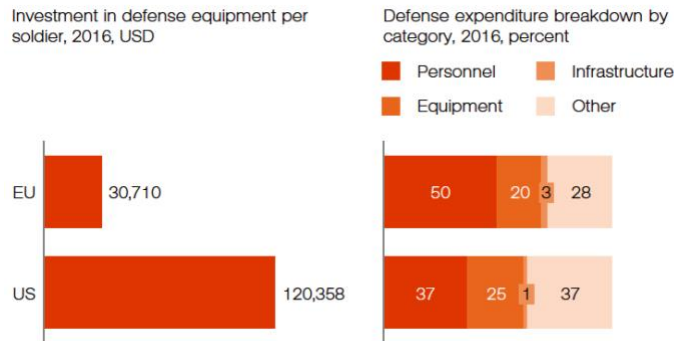


Figure 14 – Defence expenditures breakdown, US and EU compared. Source: Munich Security Report (2017)

EU. Finally, these figures are also confirmed by the first graph of table 14 showing investment in defence equipment per soldier in 2016.

The main problem of the graphs presented so far is that they do not provide a clear comprehension of the magnitude of the problem at stake. In fact, Figure 14 and Figure 15 while outlying some major patterns, they still consider the EU or European countries as a unit block. Moreover, as far as demand is concerned, the core issue regards the demanded output scale and the capability to reach the optimal production point to take full advantage of economies of scale's mechanisms. To gain deeper and more accurate insights, Table 14 shows the high EU and US military

Aircraft	National output	Total output
<i>Europe</i>		
Saab Gripen	204	242
Dassault Rafale	294	294
Eurofighter Typhoon	596	683
<i>USA</i>		
F-15	1,120	1,571
F-16	2,231	4,500+
F-18A/F	1,591	2,046
F-22	187	187
F-35	2,400	3,100+

Source: Web pages.

Note

Total output comprises national output and exports. Output changes with new orders and some figures are based on plans (e.g. for Typhoon and F-35). National output for Typhoon is for the four partner nations.

Table 14 - EU and US military aircraft output (2011)

Source: Hartley, K., 2012

the 2017 Munich Security Conference shows the US equipment accounts for 25% of the total defence expenditures compared to only 20% in the total EU military budget (Figure 15). For, not only the US military spending is far higher compared to EU one, but it is also the case for the US defence strategy to invest more in defence equipment compared to the

aircraft output differential. As regards, it is possible to draw two main considerations: first, the US clearly predominates in terms of aircraft sold both as for national and total output; second, while the US' fighters are overall non-concurrent (beyond some exeptions – i.e. F.22 and F-35), the EU presents three different fighters' models that are competing for the same market.

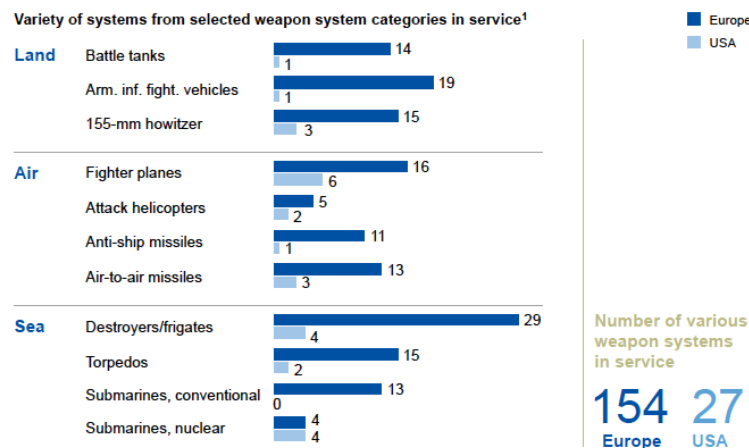


Figure 15 - Weapon systems available, USA and Europe compared (2012) Source: McKinsey, 2012

In fact, at European level, the defence procurement of European member states is still highly fragmented and there is not a real coordination. Some steps have been done towards a closer cooperation since the early 2000s, with the new procurement directive in 2009 ⁴²; however, the situation is still pretty dire. Figure 15 shows the high fragmentation of

European market, displaying the variety of systems from selected weapon categories in service. More than a supply shortcoming, Figure 15 highlights the high fragmentation of the European defence procurement process. Theoretically, high fragmentation does not necessarily mean low productivity levels, the main problem being the capacity to reach the *mes* threshold in order to fully exploit existing economies of scale: from a demand standpoint, the level of fragmentation points out to consolidation opportunities. In fact, if member states were able to guarantee the optimal demand of military systems, there would be no need to push for integration. However, in case of shrinking budgets and limited availability of government resources, another way to reach the minimum efficient scale is by unifying national procurements at the European level which would significantly improve the overall European budget for defence matters (Figure 14). Finally, beyond being able to understand the Mogherini's statements reported at the beginning of this chapter, it is possible to conclude that, while the EDITB has been able to catch up in terms of many production indicators, the lack of a consistent military demand is the main problem for the European defence sector. This lack arising not only from the amount of the aggregate military expenditure but foremost from the high fragmentation of the European defence spending.

3.3. Conclusions

This chapter has provided an analysis of the supply and demand structure of the EU and US defence market. In order to detect the reasons of the differing results of European and American defence businesses, in the first section it has been argued that the causal link runs from productivity

⁴² McKinsey, (2013) *The Future of European Defence: Tackling the Productivity Challenge*, McKinsey & Company

improvements to better performance. Thus, it would be sufficient to show the differing productivity levels of military companies across the Atlantic to prove the output difference. However, it is rather difficult to find productivity measurements especially as it comes to dual-technology firms. At the same time, the important economies of scale running in the defence sector have facilitated the task of detecting the causal issue: in order to fully exploit productivity enhancements and scale economies, some necessary - though not sufficient - structural conditions have to be met. First, from a supply-side standpoint, the high initial investments have to be coupled with a significant firm size in order to avoid input-shortages constraints: respectively, intangible assets and research and development costs have been used to operationalize investments levels, while tangible assets and number of employees have proved to be reliable proxy for company size measures. Interestingly, starting in the early 2000s, European defence firms have on average been able to catch up the American firms in terms of production structure and minimum efficient size, the only problem being the Int_Assets measure which nonetheless represents the most important measure in terms of investments and R&D effectiveness. It is the demand structure that poses major concerns as for the European defence competitiveness. In fact, European military companies do not benefit from the same scale advantages of their American rivals. The difference is evident as for macro-levels (i.e. total military spending), but also and foremost as it comes to output delivered (recall Table 14). Moreover, it has been shown that as the EU High Representative of Foreign Affairs Federica Mogherini pointed out recently, the main problem concerns the fragmentation of the European spending: for EU Member States could significantly improve their overall demand if they were to coordinate their procurements processes. On balance, is it possible to derive some policy conclusions from the previous analysis? Should the EU focus on ways to increase the investment effectiveness, pushing forward innovation? Or is it more important for the EU the focus on demand consolidation? The next chapter will try to answer some of these questions.

4. Causal Relations and Policy Advices

In the last chapter of this study we would like to provide some advices for the future EU Member States' cooperation as regards to the industrial policy of the defence sector aimed at the creation of a solid EDITB. Taking a wider perspective on the history of the European industrial policy, the European Union has struggled since the very beginning to build its own industrial champions. Interestingly, it might be possible to read the entire European economic and social integration process as the necessity to create a single market where European enterprises could flourish and catch up with the American primes ⁴³. Though in many sectors European businesses have been able to mirror and sometimes even take over American companies, it is widely known that the European defence sector accounts as one of the least integrated ⁴⁴— whence its lack of competitiveness in the international sphere. What might explain the lack of consolidation in the military and how is it possible to overcome its most important obstacles?

4.1. The Single Market Program

The Single Market Program aimed at the creation of an integrated market where goods, capitals and people could freely move without being hampered by any barrier. The main objective of the programme was to enable European companies to benefit from an increased demand at zero costs and fully exploit the existing economies of scales; at the same time, according to the liberal ideology, consumers would have taken advantage from the increased levels of competitiveness which would have engendered lower prices and higher quality. Even though some technical barriers to trade (TBT) remain as the main obstacle to fully exploit the benefits of a fully-fledged European market, after roughly 20 years from its implementation many analysts and professionals have stressed the positive results as well as the dark sides of the SMP ⁴⁵. In fact, the implementation of a single market at European level has created winners and losers: bigger companies have taken over smaller ones and the distribution of M&As have not been proportional among EU Member States. In particular, member states with an already solid and more competitive industrial apparatus have been favoured since their enterprises could benefit from a larger demand and so increase their productivity levels, without fearing other competitors. This process was also one of the main reasons of the

⁴³ Defraigne, Jean-Christophe (2013), *Introduction à l'économie européenne*, De Boeck Supérieur, Bruxelles.

⁴⁴ Hartley, K. (2012). *The Economics of Defence Policy*, Routledge, Abingdon (U.K.).

⁴⁵ Defraigne, Jean-Christophe (2013), *Introduction à l'économie européenne*, De Boeck Supérieur, Bruxelles.

implementation of European structural funds: the commitments to give up protectionist practices was counterbalanced by grants issued to less fortunate regions or States in order to restructure and face the increased level of competitiveness. In case of the SMP implementation it has been quite easy to identify protectionist practices and way to abolish them: the main problems concerning tariffs, quotas and TBTs. However, as it come to the defence sector it is rather more difficult to understand what we mean for protectionism: here, the specific nature of military market and its monopoly-monopsony combination make it difficult to distinguish protectionism simply from divergent preferences. For, even though we were to totally give up protectionist practices and entry barriers while fully privatize national military industries, member states could still prefer to buy national and no integration would ever occur. Moreover, as noted by Franco Mosconi, free market liberalization it is not the only policy that have been implemented in order to create the so called European Champions⁴⁶. The author of *The New European Industrial Policy* emphasises the role that government cooperation and rationalization have played in building the European Champions of Type I – one of the most important examples being the creation of Airbus. It is in this sense that many have talked about the Airbus of the seas referring to the last strategic Franco-Italian cooperation as for the acquisition of the French STX by the Italian National Champion Fincantieri ⁴⁷. Nonetheless, before moving forward in the discussion, it is important to briefly address the specific nature of the defence market.

4.2. The Specific Nature of the Defence Market

As already mentioned, from a supply-side standpoint, the defence sector presents high levels of concentration due to its important fixed costs, the natural monopoly often being the normal case. At the same time, from a demand perspective, the state is often the only privileged customer: whence a monopsony situation. Though the supply structure of the military sector is similar to other high-tech intensive sectors such as the pharmaceutical or the automotive where integration occurred on a larger extent, what makes defence particularly special is the monopsony power of the state. It is not just about the narrow market demand (whereas some states like the US can still grant a large requests of military products) but the nature of the actor we are dealing with. In fact, it is difficult to compare a state to a common consumer: first, state's preferences are ranked in peculiar ways and second

⁴⁶ Mosconi, F. (2015), *The New European Industrial Policy*, Routledge, New York

⁴⁷ Tran P and Kington T. (2017), *France wants naval industry tie-up with Italy*, (online), Defence News , Accessible at: <https://www.defensenews.com/naval/2017/09/06/france-wants-naval-industry-tie-up-with-italy/> (Accessed 10 September 2017)

governments do not react to the same incentives of a common consumer. In particular, as far as the latter element is concerned, states might be insensible to price and quality variations, being their interest often driven by consensus issues. For, the state is naturally driven by protection concerns – as protection meaning the well-being of its voters. Furthermore, also economic and technological factors might play an important role as for the procurement decision of the national states to buy from its own defence primes: for instance, it is often the case for the defence sector to present higher levels of productivity compared to other industries, which makes it an important asset as for the long term economic and strategic needs of national states ⁴⁸.

4.3. European Champions of Type I and Type II

Once it has been proven the massive economies of scales running in the defence sectors, it is all about to find ways to fully exploit their potential. Following a different terminology, nowadays the main objective as for a successful European industrial competitiveness concerns the creation of the so-called European Champions. Even though they started to be part of the political propaganda and high-level discussions in the European scenario, it is not straight to define what we mean for “European Champions” ⁴⁹. For example, in 2006 Angela Merkel expressed herself with these words: “The European Union will be able to exploit the chances offered by the single market – and this is my firm conviction – only if we decide to create European Champions” ⁵⁰. Franco Mosconi has tried to define a typology for this case, but it still subject to debate how to measure whether we are dealing with national firms operating on a European playing field or truly fully-fledged European businesses. From a demand standpoint, it is quite easy to detect a European company: for example, the firm should have a significant proportion of their sales in other European markets, different from the national one. However, things might complicate as regards to the supply side: it is not only a demand issue and companies should also present an organizational or ownership structure at European cross-country level. In any case, beyond the valuable, though temporary useless definition matter, it is rather important to understand which policies have been implemented in order to create the notorious European Champions. As already mentioned, Franco Mosconi in *The New European Industrial*

⁴⁸ Hartley, K. (2012). *The Economics of Defence Policy*, Routledge, Abingdon (U.K.).

⁴⁹ Mosconi, F. (2007), *The Single Market and the Development of European Champions*, (online) Available at: <http://dspace-unipr.cineca.it/bitstream/1889/866/1/Mosconi.pdf> (Accessed 10 July 2017) paper

⁵⁰ Merkel, A. (2006) *Rede von Bundeskanzlerin Dr. Agnlea Merkel auf dem WDR Europa-Forum am 9. May 2006 in Berlin* (www.bundesregierung.de)

*Policy*⁵¹ identifies two processes that engendered two different types of European companies: Type I and Type II, respectively. In the following part of this section, we will try to analyse these two types of producers, in lights of the defence sector's specificities. "European Champions" named Type I are companies that have been created from intergovernmental cooperation between EU Member States, the most notorious and successful example being the advent of Airbus. As it comes to defence, it is rather easier to build companies of this kind, since their ownership is often partly detained by national states. For, it is just about a cooperative governmental initiative to create a cross-border Champion, reduce duplication costs and increase investments levels and the size of national firms while partly giving up the sovereignty priority. At the same time, it is important that the new firm can benefit from an increased output demanded and a joint procurement of member states. In this case, governments have all the interest to purchase from the new cross-national firm: for, demand consolidation naturally follows supply integration. On the contrary "European Champions" of Type II are the products of different dynamics and major problems arise as it comes to apply this category of companies to the defence sector specificities. In fact, Type II European Champions are large enterprises that have been created thanks to private cross-borders M&As. For, these types of companies have seen the light thanks to free market and liberalization policies which have engendered waves of fusions and acquisitions to face increased levels of competitiveness. As already mentioned, as far as the defence sector is concerned, it is rather difficult to identify liberalization policies: here, we are not in presence of tariffs, quotas or other protectionist policies. For, the purchasing behaviour of the state is the only source of demand: in other words, as for the military market, the industrial and trade policy of the state corresponds to the procurement practices and rules of the government. For, the usual economic model of suppliers, consumers and governments as third actors have to be revised: in other more traditional markets, governments intervene by modifying the constraints, premises and rules of the game; this is the normal way the legislator acts to implement more or less protectionist or liberal policies. However, in the defence market, the monopoly-monopsony pair configuration does not allow any different actor to intervene and regulate the game. Arguably, this last statement could be corrected in light of the significant role and action of some supranational bodies such as the European Commission (EC), the European Court of Justice (ECJ) and the European Defence Agency (EDA)⁵².

⁵¹ Mosconi, F. (2015), *The New European Industrial Policy*, Routledge, New York

⁵² Morth, U. (2011), *Competing frames in the European Commission – the case of the defence industry and equipment issue*, *Journal of European Public Policies*, 7:2, 173-189

Reportedly, these bodies have played at the supranational European level an important role of coordination and acted as real third actors in the strict dichotomous dynamic of the European defence market. In particular, their action has focused on incentives (in the forms of grants, projects and coordination services) to shape and drive the European defence integration: accordingly, it is possible to say that the EC and EDA have been trying to implement a real defence industrial policy at a supranational level. The main obstacle to the EU action has been the enforcement and the legal constraints which exempt the defence products to be subject to the rules of the Single Market Program (art. 346 TFEU). However, the EC and the European Court of Justice have been greatly committed to increase the level of control and enforcement of some European directives concerning the defence industry⁵³. All these actions ended up in the EU Defence and Security Procurement Directive 2009/81/EC⁵⁴. The analysis of this legislative process is beyond the scope of the present work whereas in the following section we would like to stress the most important economic mechanisms available to shape the defence market. For, how is it possible to implement liberal policies, open up defence markets in a situation that lacks the presence of a third actor?

4.4. Integration Policies for the Defence Market

First of all, from a supply side standpoint, it is necessary to fully privatize the ownership of the firms: in fact, company owners would not dare to acquire a firm which is partly retained by a national government⁵⁵. Once again, the reason refers to the different objectives that public and private sector actors pursue: the latter being driven by a profit logic whereas the former also following other social or non-economic priorities. On the contrary, as far as demand is concerned, the matter is way more complex. In fact, since in this case it is not possible to intervene on policies that might modify and shape the consumers' behaviour, it is necessary to modify the action of the government: for, the only possible way is to constrain the behaviour of the legislator and make it acting "as if" it was in a free market and liberalized environment. For, public procurement directives should force the state to act as a normal consumer, reacting to the same incentives and being mainly driven by quality or price

⁵³ Blauburger, M. and Weiss, M (2013), *'If you can't beat me, join me!'* How the Commission pushed and pulled member states into legislating defence procurement, *Journal of European Public Policies*, 20:8, 1120-1138

⁵⁴ Trybus, M. (2014), *Buying Defence and Security in Europe. The EU Security and Procurement Directive in Context*, Cambridge University Press, Cambridge (U.K.).

⁵⁵ Britz, M. (2010), *The Role of Marketization in the Europeanization of Defence Industry Policy*, *Bulletin of Science, Technology & Society* 30(3) 176-184, SAGE Publications

factors while divert the attention from social, political or strategic needs. However, this solution is extremely complex and difficult to enforce on a European level. Member States could keep favouring national priorities and primes while no integration would occur at a European level, due to the lack of a real free market. At the same time, it should be recalled that the main objective should be the full exploitation of existing economies of scale. For, another possible way might be to coordinate the demand in order to make use of the advantages that might arise from privatization and supply integration. Under a pure institutional point of view, this latter possibility represents a more feasible and realistic solution, since national States might be forced by supranational organizations and agencies to give up their procurement sovereignty rights. The outcome of this latter possible arrangement would be a full demand consolidation of defence procurement at European level. In the past decades, many have been the efforts to coordinate the military procurements on a European level. Some organizations such as the Organization for Joint Armament Cooperation (OCCAR) or the European Defence Agencies have been also established to pursue cooperation in procurements processes; certainly, even though it is too early to assess its impact and relevance, also the last developments of the PESCO will significantly affect this subject. Martin Trybus in *Buying Defence and Security in Europe*⁵⁶ provides an accurate assessment and extensive review of procurement directives within the European scenario both at a community level and as regards to intergovernmental cooperation on defence matters. However, further insights on historical developments and state of the subject as regards to the legal environment of the defence sector are beyond the scope of this study and will not be undertaken. On the contrary, what is important to stress are the relevant results that can be derived from the analysis that have been run: what should be done to concretely follow up to the major results of the present study?

4.5. Supply and Demand: disentangling the mechanism

First of all, as for the production side, it has been found that European defence firms presents similar levels of R&D spending and size compared to US defence companies. For, it is possible to state that the European defence sector has been able to catch up in terms of efficient size and production capabilities. The only problem regards intangible assets measures that are still lagging behind compared to US levels. However, this latter factor represents a minor concern, since it is difficult to evaluate the effectiveness of the increase European R&D spending over the past 15 years: the

⁵⁶ Ibid.

intangible asset deficit might still reflect the insufficient R&D spending prior to the change of the mid-2000s and therefore it might be just a matter of time for their levels to catch up with the US industry – the time to fully exploit learning by doing effects on which the US defence industry has already capitalized (see below); otherwise, it might be revealed as a real structural problem concerning the effectiveness of European investments. However, it is still too early to analyse where the problem comes from. Overall, the supply side analysis made it clear that the lack of efficiency of European firms does not arise from a productive drawback which hamper the possibility to produce the necessary output levels to exploit economies of scales. In fact, according to our analysis the most important deficit of the European defence market concerns its demand: the output of purchased military systems is significantly lower compared to the US one, whence the impossibility for European defence primes to reach the minimum efficient size of their American competitors. Arguably, this situation is possible because of the high supply fragmentation at the European level – i.e. the national states preferring to support their firms. Nonetheless, the causal link runs from demand fragmentation to lack of performance at industry level, whereas supply fragmentation is just a natural corollary. In fact, first, if there were a fully integrated supply structure, member states might still decide to buy military equipment from abroad and the efficiency of a European defence prime would not be guaranteed; and secondly, if European firms were guaranteed a sufficient demand to meet their minimum efficient size as in the American case, supply integration might be even redundant since it would not significantly increase European structural doing compared to the US example. However, it might be argued that the causal link goes as well the other way around: for in case of fusion of two firms A and B which belong to two different states both the governments will start to purchase from C, the new firm born from the A-B fusion. However, in case C completely or massively relocates in one of the two states because of some economic advantages, the state who loose will have no more tiding reasons (i.e. job or technological protection) to purchase from C. For, the new-born company should keep some production facilities and services in both countries which would be interested in keeping alive the firm's business. In this regard, an interesting case is represented by the acquisition of the Swedish defence prime Saab Gripen from the British BAE Systems: from 1998 to 2005, BAE Systems has been the main shareholder of Saab. Beyond identity concerns, the Swedish government is still purchasing from its former national champion, according to its foreign military strategy of “non-alignment”: perhaps, BAE Systems kept producing through Saab because it feared that the Swedish government would otherwise turn to other foreign competitors; for, even though perhaps be sub-optimal, it could be a fair and profitable compromise to keep the Saab subsidiary opened while

benefitting from the Swedish government's procurement. However, in this latter case there would not be a real production rationalization: duplication costs would not be really reduced and the necessity to reach bigger economies of scales will be pursued at increasing costs. Perhaps in this case the productive efficiency might be increased by other factors such as technological transfers or know-how exchanges. For all these reasons, the main matter of concern is demand consolidation and perhaps future policies should first concentrate their attention and efforts on this aspect. If European defence procurements were to be rationalized, the suppliers would naturally integrate and consolidate as well and it would be possible to increase the efficiency of the primes. At the same time, is building an EDTIB on a sole supply integration basis no more interesting? Particularly as it comes to exports, M&As allows firms not only to merge their supply sides but also to access markets shares of their previous competitors. Also in this case, the determining role of supply consolidation is given by the possibility to increase the international demand for the products of the firm as well as benefitting from the lobbying capacity and commercial penetration of the respective national states. Once again, whether we are dealing with supply or demand consolidation, it should be stressed the importance of policies which target firstly the possibility to increase the demand. At the same time, it worth noticing the major impact that internal demand and procurement plays as of the overall performance of defence national primes. In fact, the structure of the defence contracts is notably long-term; exports are far more volatile and unstable respect to the domestic demand: the only actor who is able to guarantee a firm to make a 15-20 years' investment in R&D is the national state. For, firms who benefit from a large internal demand (like in the US case), can exploit another important mechanism which significantly lower marginal costs and increase productivity levels: this mechanism is the "learning by doing effect" which has been largely proven to be present in the defence industry⁵⁷. Though forming part of the economies of scale's concept, while perhaps also explaining some of the intangible assets issues, the learning by doing effect is particularly relevant to point out again to the importance of the internal demand. Once again, for all the reasons mentioned and due to the limited time and resources available, demand consolidation should be preferred to other policies to increase the overall European defence competitiveness.

⁵⁷ Hartley, K. (2012). *The Economics of Defence Policy*, Routledge, Abingdon (U.K.).

4.6. Conclusions

The main objective of the present study has been to analyse the most significant strengths and weaknesses of the European defence industry compared to the US example. Even though the overall assessment lacks some important expertise in the fields of military systems, defence companies and historical developments of European and American defence industry, it has been possible to accurately show some big patterns and argue in favour of the necessity of some structural changes. The Structure-Conduct-Performance model that has been applied to study the European defence industry has provided important results concerning the main deficiencies which lie as core explaining elements for the European lack of competitiveness in the international arena. For, even though the author is aware that there might be other possible theories, all the reasoning is based on the assumption of the validity of this model as a way to possibly explain some important facts of the European defence industry. First of all, through an accurate literature review of professionals' and experts' opinions, it has been shown that in terms of quality, European military systems cannot be compared to the technological superiority of major US products: particularly as it comes aircrafts, the US can exploit a significant quality advantage in the international markets. The US lead is mainly due to some new and high-tech components such as radars, digital and sensors systems. In a wider perspective, this is an interesting insight since also the European Commission industrial policy, in the past decade, have acknowledged the necessity to increase investment levels in the so-called "enabling technologies" to strengthen the overall European companies' competitiveness. Furthermore, in order to accurately compare the conduct of EU and US defence industries, it has been analysed the export performance of EU and US companies at country level by major military systems. Once again, it has been stressed the supremacy of the United States, even though for some products European export levels appear to progressively catch up or even take over US ones. Following this general comparative analysis of the EU and US business doing, we moved to the performance evaluation. For, according to the S-C-P model, we found that on an industry level, US companies are on average performing better compared to European firms. Here the major difficulties have been the choice of more reasonable indicators for the financial assessment which, though methodologically coherent, it has only been possible to provide some general insights due to the dual technological nature of military companies. Finally, the structural analysis allowed to give some policy advises as regards to the necessity to concentrate future efforts particularly on demand consolidations. All the statements are subject to the premise that a significant lack of data and sources might have hampered the analysis

and its conclusions. However, the main results are corroborated by other studies and evidences that have been found as regards to the topic studied. Eventually, we also think that the study has been able to undertake a salient issue in the international debate: nowadays, building a solid European Defence Technological and Industrial Base, able to properly supply military, strategic and economic needs is an important objective and challenge for the EU Member States and the future of the European Union.

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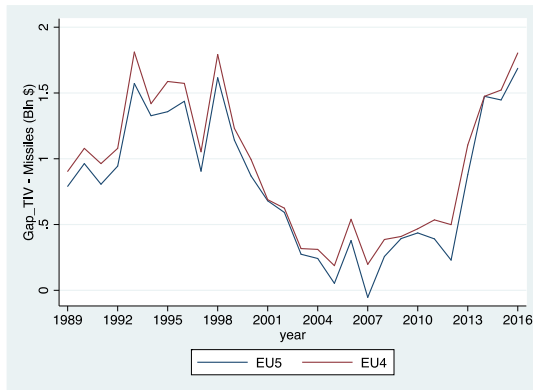
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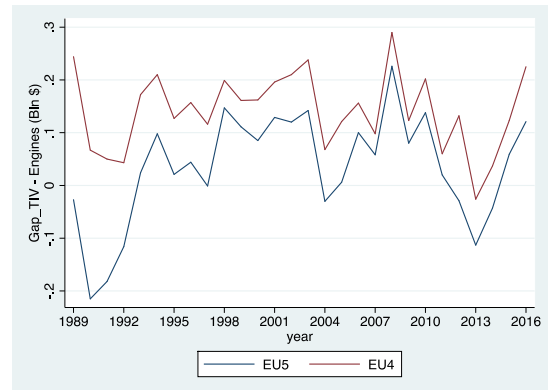
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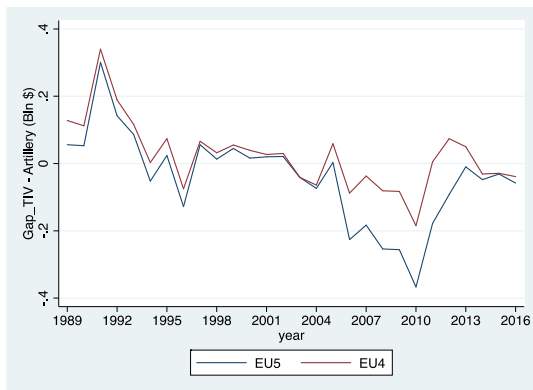
ANNEX I



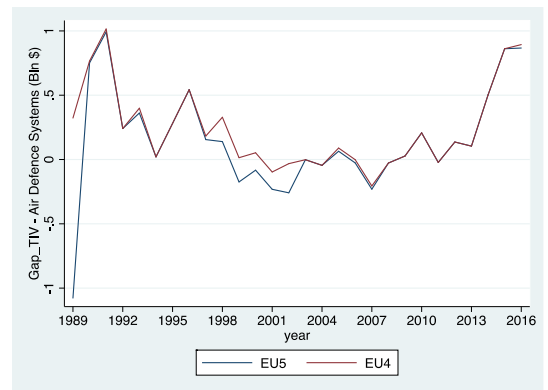
Gap_TIV for Missiles



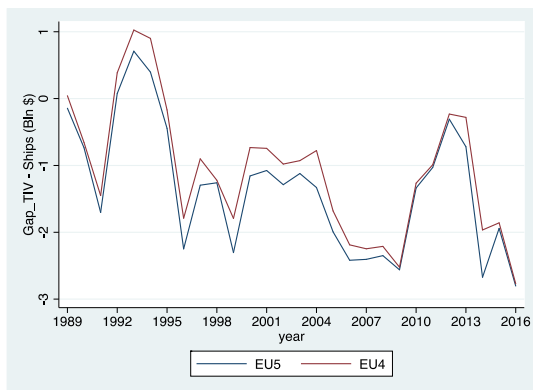
Gap_TIV for Engines



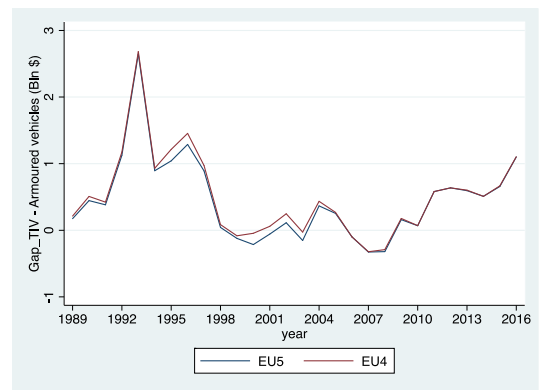
Gap_TIV for Artillery



Gap_TIV for Air Defence Systems



Gap_TIV for Ships



Gap_TIV for Armoured Vehicles

Source: SIPRI Database

ANNEX II

Company	Country	Sector	Number of Sectors
US			
Lockheed Martin Corp.	United States	Ac El Mi Sp	4
Boeing	United States	Ac El Mi Sp	4
General Dynamics Corp.	United States	A El MV SA/A Sh	5
Raytheon	United States	El Mi	2
Northrop Grumman Corp.	United States	Ac El Mi Sh Sp	5
L-3 Communications	United States	El	1
United Technologies Corp.	United States	Ac El Eng	3
SAIC	United States	Comp(MV) Ser	1
Ungtington Ingalls Industries	United States	Sh	1
Honeywell	United States	El	1
	Average		2,7
Europe			
BAE Systems	United Kingdom	Ac A El MV Mi SA/A Sh	7
EADS	Trans-European	Ac El Mi Sp	4
Finmeccanica	Italy	Ac A El MV Mi SA/A	6
Thales	France	El MV Mi SA/A	4
Safran	France	El	1
Rolls-Royce	United Kingdom	Eng	1
DCNS	United Kingdom	Sh	1
Saab	France	Ac El Mi	3
Rheinmetall	Trans-European	A El MV SA/A	4
Babcock International Group	Italy	Sh	1
	Average		3,2
	Average (*)		3,3

Operating military sectors of top-10 US and European military companies, 2011

Source: SIPRI Yearbook, 2012